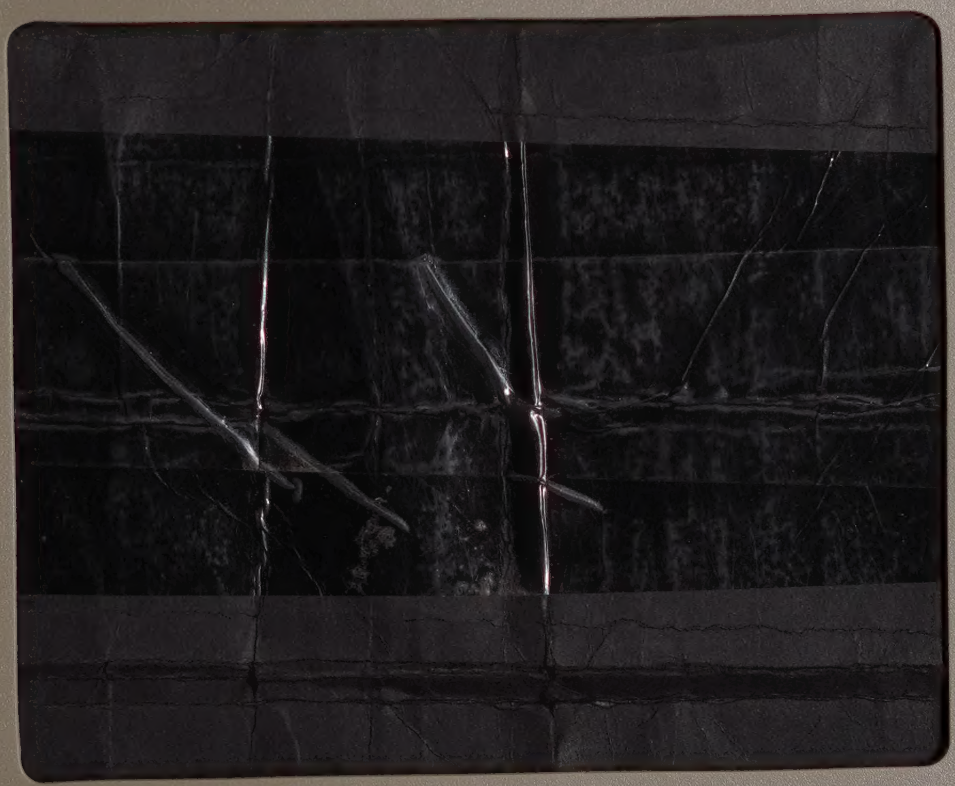
METROLOGY
BLDG-28



FLUKE®

NOTE

This manual documents the Model 8522A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

8522A
Digital Multimeter

Service Manual

P/N 629246
July 1982
©1982, John Fluke Mfg. Co., Inc., All rights reserved. Litho in U.S.A.

FLUKE®

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1 year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90 days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"* prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

Table of Contents

SECTION	TITLE	PAGE
1	**INTRODUCTION AND SPECIFICATIONS**	**1-1**
	1-1. THE 8522A INSTRUCTION MANUALS SET	1-1
	1-4. LIST OF RECOMMENDED TEST EQUIPMENT	1-1
	1-6. SPECIFICATIONS	1-2
2	**SHIPPING AND SERVICE INFORMATION**	**2-1**
	2-1. SHIPPING INFORMATION	2-1
	2-4. SERVICE INFORMATION	2-1
	2-7. QUESTIONS	2-1
3	**THEORY OF OPERATION**	**3-1**
	3-1. INTRODUCTION	3-1
	3-3. COMPONENT NUMBERING SYSTEMS	3-1
	3-5. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION	3-1
	3-7. DC Volts	3-1
	3-9. AC and DC + DC Volts	3-5
	3-11. Ohms and Nanosiemens	3-5
	3-13. External Reference	3-5
	3-15. External Trigger Inputs	3-5
	3-17. Digital Data Flow	3-5
	3-19. DETAILED DESCRIPTION	3-5
	3-21. Power Supply (8522A-1023)	3-5
	3-29. Display Assembly (8522A-1011)	3-5
	3-29. Digital Assembly	3-6
	3-64. Analog Assembly	3-19
4	**INSTRUMENT ASSEMBLY/DISASSEMBLY**	**4-1**
	4-1. INTRODUCTION	4-1
	4-3. TOP/BOTTOM COVER	4-1
	4-5. TOP ANALOG GUARD COVER	4-1
	4-7. INTERNAL GUARD COVERS	4-1
	4-9. DC Buffer Guard	4-1
	4-10. AC Converter Guard	4-1
	4-11. FRONT PANEL DISPLAY ASSEMBLY	4-1
	4-13. ANALOG ASSEMBLY	4-2
	4-15. TRANSFORMER AND TRANSFORMER ASSEMBLY	4-2
	4-17. DIGITAL ASSEMBLY	4-2
	4-19. BOTTOM ANALOG SHIELD	4-3

(continued on page ii)

TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
5	**TROUBLESHOOTING**	**5-1**
	5-1. INTRODUCTION	5-1
	5-4. POWER ON PROCEDURE	5-1
	5-8. SPECIAL PROCEDURES	5-1
	5-10. ANALOG CONTROLLER TESTS	5-1
	5-12. Analog Controller Input Signals	5-2
	5-14. Latch Test	5-2
	5-16. UART Test	5-2
	5-18. Interrupt Test	5-2
	5-20. UART and Interrupt Troubleshooting Procedures	5-3
	5-22. A/D Converter Test	5-3
6	**LIST OF REPLACEABLE PARTS**	**6-1**
	TABLE OF CONTENTS	6-1
	6-1. INTRODUCTION	6-2
	6-4. HOW TO OBTAIN PARTS	6-2
7	**GENERAL INFORMATION**	**7-1**
7A	**MANUAL CHANGE INFORMATION**	**7A-1**
8	**SCHEMATIC DIAGRAMS**	**8-1**
	TABLE OF CONTENTS	8-1

List of Tables

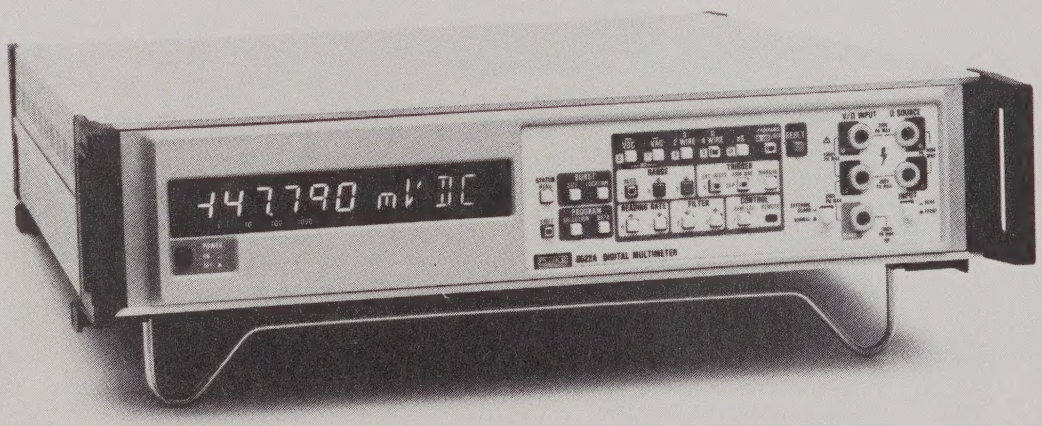
FIGURE	TITLE	PAGE
1-1.	Test Equipment	1-2
1-2.	8522A Specifications	1-3
3-1.	Component Identification	3-1
3-2.	Remote Interface Electrical Specifications	3-16
3-3.	Remote Interface I/O Signals	3-20
3-4.	Filter Settings	3-22
5-1.	Front Panel PCB Troubleshooting	5-4
5-2.	Digital PCB Troubleshooting	5-6
5-2A.	Digital PCB Troubleshooting with the Fluke 9000 Series	5-10
5-3.	Analog PCB Troubleshooting	5-14
5-4.	Error Codes	5-15
5-5.	Typical Voltages and Waveforms	5-16
5-6.	Keyswitch Test	5-17
5-7.	Analog Test Failure Patterns	5-18
5-8.	Analog Controller Latch Outputs	5-18
5-9.	Low Ohms Test	5-25
5-10.	Analog Controller Latch Tests	5-25
5-11.	Analog Controller UART Test	5-26
5-12.	Analog Controller Interrupt Test	5-26
5-13.	UART and Interrupt Troubleshooting Procedures	5-27

Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_11649

List of Illustrations

FIGURE	TITLE	PAGE
Frontispiece	8522A Digital Multimeter	vi
1-1.	8522A Instruction Manual Set	1-2
1-2.	Outline Drawing	1-7
3-1.	Assembly Placement	3-2
3-2.	8522A Block Diagram	3-3
3-3.	DC Volts	3-4
3-4.	AC Volts and AC + DC Volts	3-7
3-5.	Ohms and Nanosiemens	3-8
3-6.	External Reference DC Volts	3-9
3-7.	External Trigger Inputs	3-10
3-8.	External Trigger Timing	3-11
3-9A.	Four-wire Data from 8522A	3-12
3-9B.	Four-wire Data to 8522A	3-13
3-9C.	Three-wire Data to 8522A	3-14
3-9D.	Three-wire Data to 8522A	3-15
3-10.	BCD External Signal Timing Diagrams	3-17
3-11.	Block Diagram of Remote CKT	3-19
3-12.	External Trigger Timing for BCD	3-21
3-13.	Remote Acknowledge Timing	3-21
3-14.	Timing Specification	3-22
3-15.	Low Ohms Measurements	3-23
3-16.	High Ohms Measurements	3-23
5-1.	Analog Self Tests #1, 2, 3 Simplified Schematic	5-19
5-2.	Analog Self Test #4 Simplified Schematic	5-19
5-3.	Analog Self Tests #5, 6, 7 Simplified Schematic	5-20
5-4.	Analog Self Test #8 Simplified Schematic	5-21
5-5.	Analog Self Tests #9, 10, 11, 12 Simplified Schematic	5-22
5-6.	Analog Self Test #13 Simplified Schematic	5-23
5-7.	Analog Self Tests #14, 15, 16 Simplified Schematic	5-24
5-8.	A/D Converter Test	5-28



8522A Digital Multimeter

Section 1
Introduction and Specifications

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

1-1. THE 8522A INSTRUCTION MANUALS SET

1-2. The John Fluke Model 8522A Digital Multimeter is documented by a set three manuals: the 8522A Operator Manual, the 8522A Calibration Manual, and the 8522A Service Manual. The 8522A Operator Manual introduces the operator to the 8522A, familarizes the operator with all instrument controls, connectors, and indicators, and presents detailed local and remote operating information and procedures. The 8522A Calibration Manual provides general maintenance procedures, Perfomance Tests, and Calibration Adjustment procedures. The 8522A Service Manual contains the theory of operation, troubleshooting information, a list of replaceable parts, and schematics. As Figure 1-1 shows, the three manuals can either be seperated for use in different areas or joined together in a single binder.

1-3. The information in this, the 8522A Service Manual, is divided into eight sections:

1 INTRODUCTION AND SPECIFICATIONS
Introduces the 8522A Instruction Manual Set, lists the recommended test equipment necessary to complete the Performance Tests and Calibration Adjustments, and lists the instrument specifications.

2 SHIPPING AND SERVICE INFORMATION
If there is a problem with your 8522A, this section describes how to get it corrected and how to ship the instrument.

3 THEORY OF OPERATION
Describes in detailed block diagrams the operation of the instrument at the block diagram level.

4 INSTRUMENT ASSEMBLY/DISASSEMBLY
Describes how to disassemble and reassemble the instrument.

5 TROUBLESHOOTING
A procedure to isolate faults in the instrument to a circuit or component level.

6 LIST OF REPLACEABLE PARTS
An illustrated list of components contained in the instrument. Includes the reference number, nomenclature, Fluke and Manufactures Part number, Manufactures Code and Quantity.

7 GENERAL INFORMATION AND MANUAL CHANGE INFORMATION
Information allowing the reader to backdate the manual to any previous revision level.

8 SCHEMATICS
Schematic diagrams of the electronic circuits in the instrument.

1-4. LIST OF RECOMMENDED TEST EQUIPMENT

1-5. Table 1-1, lists the test equipment required to complete the Adjustment Procedures described in this

manual. Equivalent instruments can be substituted if the recommended models are not available. The Calibration Adjustment procedure is called out as part of the Troubleshooting procedure. The DMM and Oscilloscope are also required for fault isolation; however, in some cases a logic probe, e.g., the Tektronix P6401, may be substituted for the Oscilloscope.

1-6. SPECIFICATIONS

1-7. Table 1-2 lists the 8522A specifications.

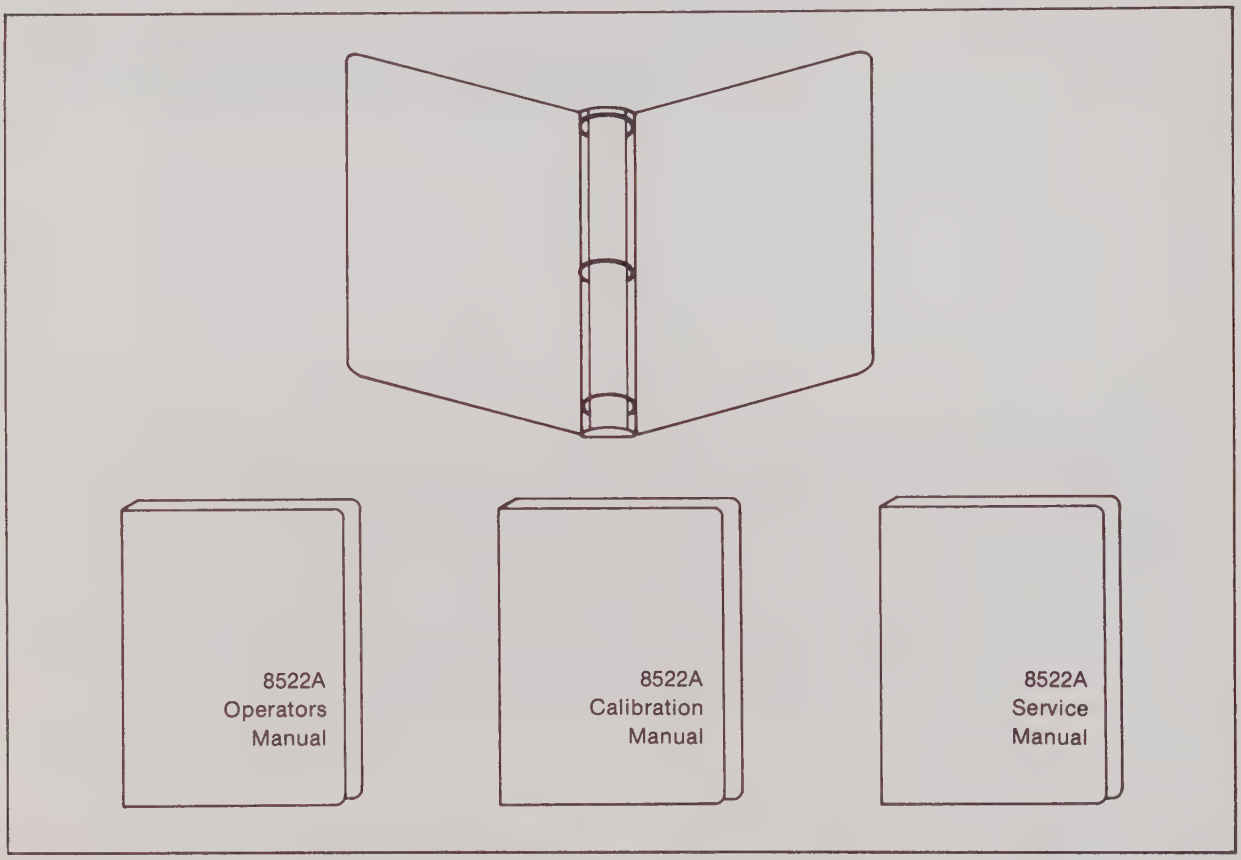


Figure 1-1. 8522A Instruction Manual Set

Table 1-1. Test Equipment

ITEM	SPECIFICATIONS (MINIMUM)	NOMENCLATURE
DMM	5½ digits 0.005% dc accuracy	FLUKE 8800A
Oscilloscope	General Purpose	TEKTRONIX T900 Series
DC Voltage Standard	0.001% Accuracy	FLUKE 332D or 335D
Ratio Standard	0.1 ppm Resolution, 1 ppm Terminal Linearity	FLUKE 720A
	≥0.03% Accuracy @ 20 kHz	FLUKE 5200A
AC Calibrator	≥0.044% Accuracy @ 20 kHz	FLUKE 5205A or 5215A
Power Amplifier		ESI 1010 100Ω and 10 kΩ,
Standard Resistor		ESI 1050 1 MΩ. ESI SB103
w/Accessories		shorting bars, ESI PC101 Parallel Compensation Network
Load	1 MΩ/1μF	1 MΩ ±1% 1/8 W, mF resistor in parallel with a 1 μF ±20% 10V capacitor
Micro-System Troubleshooter (Optional)	Microprocessor Troubleshooter	Fluke 9000 Series

Table 1-2. 8522A Specifications

DC VOLTS

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	INPUT RESISTANCE
100 mV	199.999	1 μV	≥10,000 MΩ
1V	1.99999	10 μV	≥10,000 MΩ
10V	16.0100	100 μV	≥10,000 MΩ
100V	130.000	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of input + number of digits)

RANGE	24 HOURS 23°C ±1°C	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	PLUS TEMP. COEFFICIENT PER °C *
100 mV	0.003 + 5	0.0065 + 6	0.011 + 10	0.0005 + 0.5
1V	0.003 + 1	0.006 + 2	0.011 + 2	0.0005 + 0.15
10V	0.002 + 1	0.005 + 1	0.009 + 1	0.0004 + 0.10
100V	0.003 + 1	0.007 + 2	0.012 + 2	0.0005 + 0.15
1000V	0.0035 + 1	0.0065 + 1	0.011 + 11	0.0005 + 0.10

**From 22°C to 0°C or 24°C to 50°C, 24 hours specification*
From 18°C to 0°C or 28°C to 50°C, 90 day or 1 year specification

High Speed Accuracy: ±(% of input + least significant bit)*

RANGE	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	PLUS TEMP. COEFFICIENT PER °C
100 mV	0.01 + 1	0.015 + 1	0.001 + .1
1V	0.01 + 1	0.015 + 1	0.001 + .05
10V	0.01 + 1	0.015 + 1	0.001 + .05
100V	0.01 + 1	0.015 + 1	0.001 + .05
1000V	0.01 + 1	0.015 + 1	0.001 + .05

**Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Typical Normal Mode Rejection

LINE FREQ	FILTER SETTLING TIME					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	*83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	*88 dB	91 dB
400 Hz	53 dB	56 dB	60 dB	120 dB	*123 dB	126 dB

**Guaranteed minimum rejection*

Common Mode Rejection ..... True 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR.

Maximum Input ..... ±1000V Peak, HI to LO or GUARD to chassis terminals, and ±200V Peak, GUARD to LO terminals, for any range.

Table 1-2. 8522A Specifications (cont)

Maximum Reading Rate

OPERATION	RESOLUTION	LINE	READING RATE
Local (Parallel)	5½ digits	50 Hz 60 Hz	100 rdgs/sec 120 rdgs/sec
Remote (Parallel)	5½ digits	50 Hz 60 Hz	200 rdgs/sec 240 rdgs/sec
Remote (Parallel)	4½ digits	50 Hz 60 Hz	>500 rdgs/sec >500 rdgs/sec
BCD	5½ digits	50 Hz 60 Hz	50 rdgs/sec 60 rdgs/sec

Input Current ≤50 pA for 30 days @ 18° to 28°C

AC VOLTS (TRUE RMS)

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	INPUT IMPEDANCE
1V	1.99999	4FL10 μV	1 MΩ, ≤100 pF at the V/Ω INPUT terminal
10V	16.0100	4FL100 μV	
100V	130.100	4FL1 μV	
650V	650.000	4FL10 μV	

Accuracy: ±(% of input + % of full-scale)**
For 650V range multiply % FS

FREQUENCY	24 HOURS 23°C ±1°C			90 DAYS 23°C to 28°C			1 YEAR 18°C to 28°C		
	% of INPUT	+ % FS AC	+ % FS AC+DC	% of INPUT	+ % FS AC	+ % FS AC+DC	% of INPUT	+ % FS AC	+ % FS AC+DC
10 Hz to 20 Hz*	3.0	0.5	0.6	3.0	0.6	0.7	3.5	0.6	0.7
20 Hz to 40 Hz*	0.4	0.3	0.4	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz to 20 kHz	0.08	0.02	0.06	0.1	0.03	0.08	0.15	0.05	0.16
20 kHz to 100 kHz	1.0	0.3	0.4	1.0	0.3	0.4	2.0	0.6	0.8
100 kHz to 300 kHz	2.4	0.6	0.6	2.4	0.6	0.6	4.0	1.0	1.0
300 kHz to 1 MHz	8.0	2.5	2.5	8.0	2.5	2.5	15.0	5.0	5.0

**Assumes smoothing using the Statistics Math Program (#8).*

***From 0.1% of Range to Full Scale*

Temperature Coefficient ..... 18°C to 0°C or 28°C to 50°C, to 20 kHz.
AC MODE ..... ± (.007% of input + .007% FS)/°C
AC + DC MODE ..... ± (.007% of input + .014% FS)/°C

Maximum Input ..... ±1000V, Peak HI to LO or GUARD to chassis terminals, and ±200V Peak GUARD to LO terminals for any range.

Volt-Hertz Product ..... ≤$2x10^7$ (slew rate ≤177V/uSec)

Crest Factor ..... Exceeds 4:1 @ full scale, increasing downscale.

Maximum Reading Rate ..... 10 rdgs/sec (for <300 Hz use reading rates of 5, 2, or 1 rdg/sec to insure stated accuracy

Table 1-2. 8522A Specifications (cont)

OHMS

Input Characteristics

RANGE	FULL-SCALE	RESOLUTION	CURRENT THRU UNKNOWN	OPEN CURRENT VOLTAGE
10Ω	19.9999	100 μΩ	10 mA	
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	<8V
100 kΩ	199.999	1Ω	14.5 μA(max)	
1 MΩ	1.99999	10Ω	1.5 μA(max)	
10 MΩ	19.9999	1 kΩ	1.5 μA(max)	

Accuracy :±(% of input + number of digits)

RANGE	24 HOURS 23°C ±1°C	90 DAYS 18°C TO 28°C	1 YEAR 18°C TO 28°C	PLUS TEMP. COEFFICIENT PER °C*
10Ω	0.0045 + 6	0.0080 + 7	0.0140 + 12	0.0007 + 0.2
100Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
1000Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
10 kΩ	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
100 kΩ	0.0040 + 2	0.0090 + 2	0.0140 + 3	0.0012 + 0.2
1 MΩ	0.0090 + 2	0.0160 + 2	0.0200 + 3	0.0020 + 0.2
10 MΩ	0.0300 + 1	0.0440 + 1	0.0450 + 3	0.0030 + 0.2

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input ..... ±400V peak for any range.

Maximum Reading Rate: 10/sec at 100 KΩ and above.

OPERATION	RESOLUTION	LINE	READING RATE
Local (Parallel)	5½ digits	50 Hz 60 Hz	100 rdgs/sec 120 rdgs/sec
Remote (Parallel)	5½ digits	50 Hz 60 Hz	200 rdgs/sec 240 rdgs/sec
Remote (Parallel)	4½ digits	50 Hz 60 Hz	>500 rdgs/sec >500 rdgs/sec
BCD	5½ digits	50 Hz 60 Hz	50 rdgs/sec 60 rdgs/sec

CONDUCTANCE

Range ..... 100 nS

Full Scale ..... 202.00 nS

Resolution ..... 0.01 nS

Accuracy: ±(% of input + number of digits)

24 HOURS 23°C ± 1°C	90 DAYS 18°C to 28°C	1 YEAR 18°C to 28°C	*PLUS TEMP. COEFFICIENT PER °C
0.04 + 5	0.05 + 5	0.06 + 5	0.004 + 1

**From 18°C to 0°C or 28°C to 50°C*

Maximum Input ..... ±400V peak

Maximum Reading Rate ..... 10 rdgs/sec

Table 1-2. 8522A Specifications (cont)

EXTERNAL REFERENCE

Operating Range ..... ±0.5V dc to ±33V dc as long as external reference is within ±16.5V of input LO terminal.

Input Impedance ..... 10,000 MΩ between external reference HI or LO terminals and input LO terminals.

Accuracy

X-REF VOLTAGE	ACCURACY
16.5 to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	± A + B + (400 ppm 1Vref 1)

NOTE: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input ..... ±180V peak between external reference HI or LO and input LO; ±360V peak between external reference HI and LO.

Transfer Accuracy ..... The following accuracy specifications apply when:
Filter settling time is 500 or 1000 ms.
Measurements are made more than 2 hours after warmup.
Measurements are made within one range.
Standard is checked at least every hour.
Ambient temperature stability within ±1°C.

DC VOLTAGE

RANGE	±(% OF INPUT + NUMBER OF DIGITS
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC VOLTAGE (all ranges)

FREQUENCY	±(% OF INPUT + % OF FULL-SCALE)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.007
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.060

AC VOLTAGE, DC COUPLED ..... Same as AC Voltage except 40 Hz - 20 kHz, 0.005 + 0.010.

Resistance

RANGE	±(% OF INPUT + NUMBER OF DIGITS)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance ..... ±(0.02% of input + 0.02 nS)

Table 1-2. 8522A Specifications (cont)

GENERAL	
Interface	BCD or Parallel (word serial)
Temperature	0°C to 50°C operating; -25°C to +75°C non-operating.
Relative Humidity	≤95% at 25°C, ≤75% at 40°C, ≤45% at 50°C.
Shock and Vibration	Meets MIL-T 28800B for type III, Class 5, Style E.
Power	100, 120, 220, or 240V ac, ±10%; 50,60, or 400 Hz ±5%, ≤50W.
Size	8.89 cm H/47.00 cm L/43.18 cm W (3½ in H/18½ in L/17 in W) See Figure 1-2.
Weight	9.56 kg (21 lbs)
Protection Class Code 1	Relates solely to insulation of grounding properties in IEC 348.

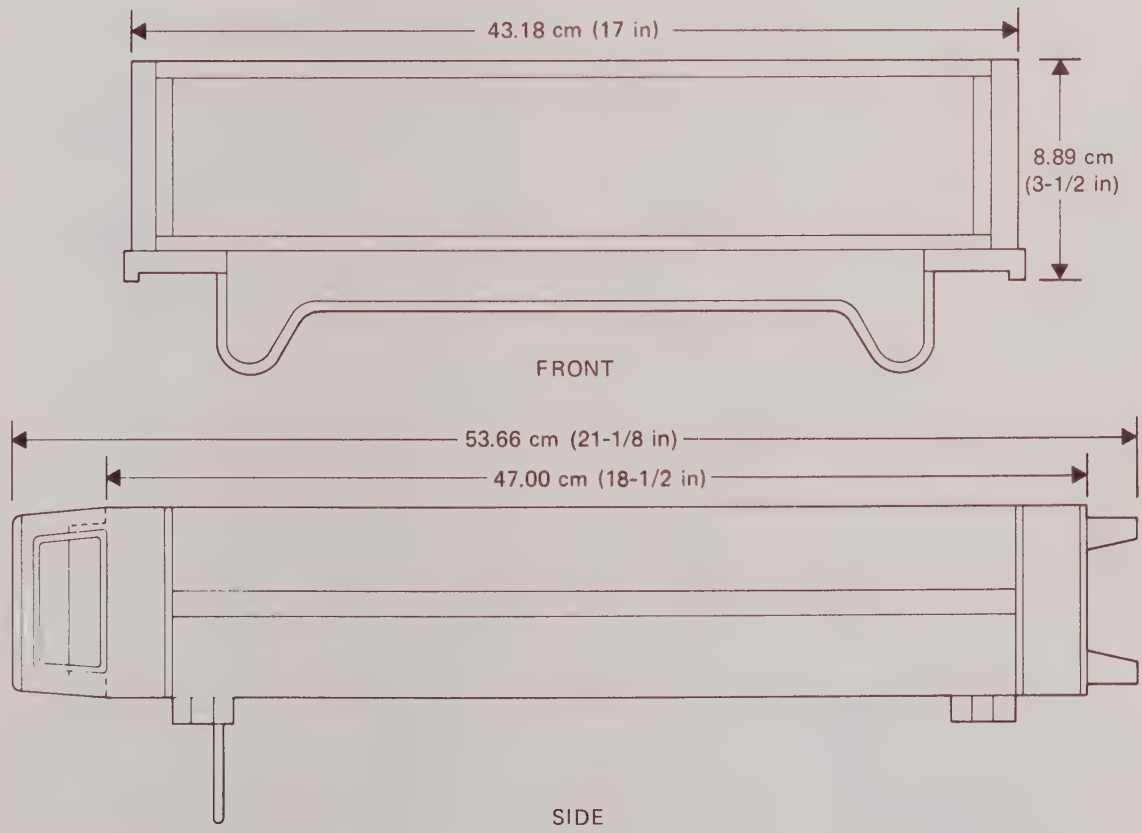
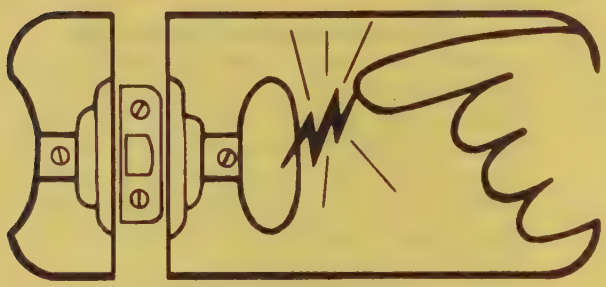


Figure 1-2. Outline Drawing

static awareness

A Message From

John Fluke Mfg. Co., Inc.

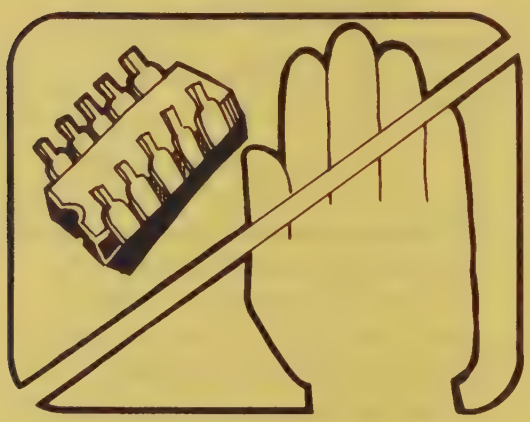


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

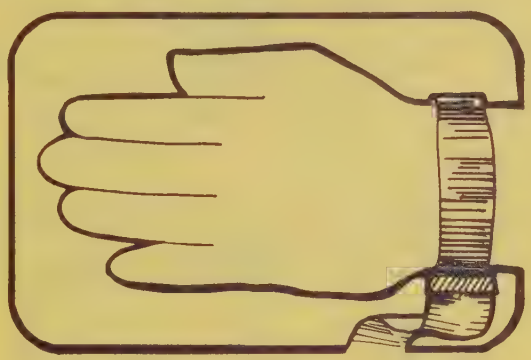
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

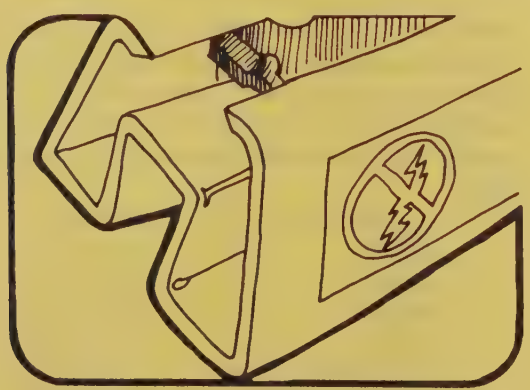
The following practices should be followed to minimize damage to S.S. devices.



1. MINIMIZE HANDLING

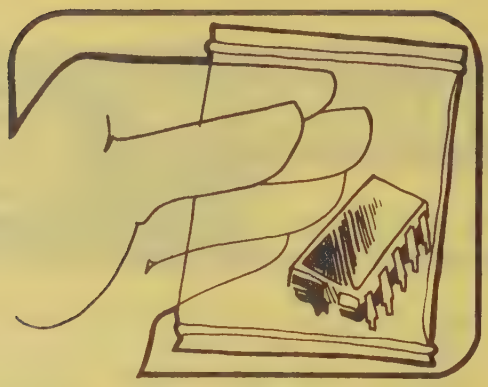


3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES

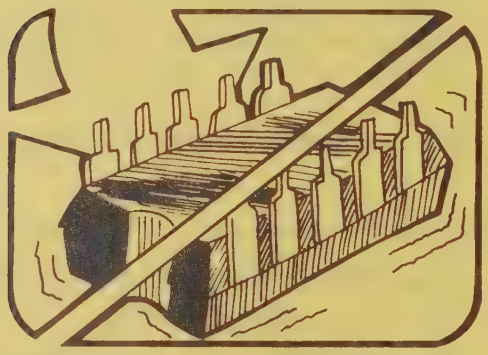


2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.

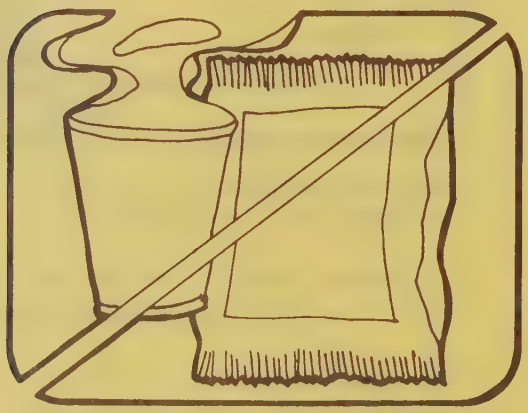
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

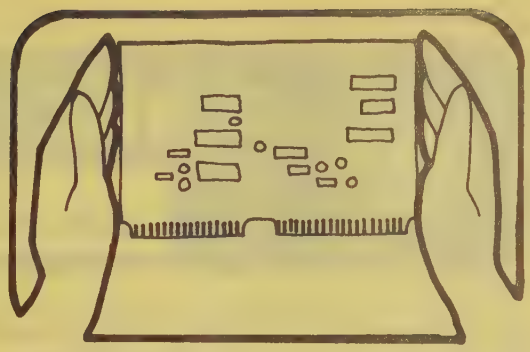


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

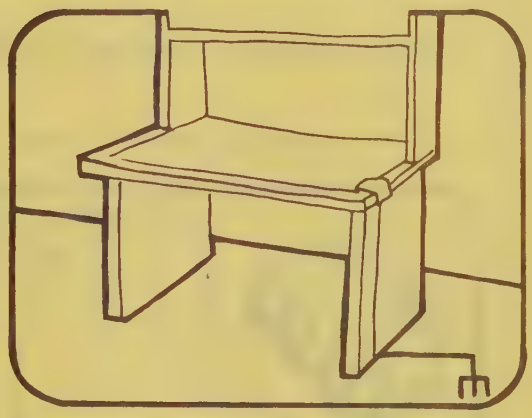


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED
WITH PERMISSION FROM TEKTRONIX, INC.
AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet 30"x60"x60 Mil P/N RC-AS-1200 $20.00	Wrist Strap P/N TL6-60 $7.00

® Dow Chemical

J0089B-07U7810/SE EN Litho in U.S.A.

Section 2
Shipping and Service Information

2-1. SHIPPING INFORMATION

2-2. The 8522A is packaged and shipped in a foam-packed container. When you receive the 8522A, inspect the instrument thoroughly for possible shipping damage. Special instructions for inspection and claims are included on the shipping container.

2-3. If reshipment is necessary, use the original container. If the original container is not available, order a new one from John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206; telephone (206)342-6300.

2-4. SERVICE INFORMATION

2-5. Each John Fluke Model 8522A Digital Multimeter is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of this manual.

2-6. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is given in Section 7. If requested, the customer will be provided with an estimate before any work begins on instruments that are beyond the Warranty period.

2-7. QUESTIONS

2-8. For additional information, contact your nearest John Fluke Sales Representative (See Section 7) or the John Fluke Mfg. Co., Inc. at the address given above.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual deals with the 8522A theory of operation. It begins with an explanation of the component numbering and placement system, followed by an overall block diagram and then a detailed description of each block.

3-3. COMPONENT NUMBERING SYSTEMS

3-4. The 8522A is laid out on four printed circuit boards designated A1 through A4 plus the switches and connectors mounted on the front and rear panels. The two main boards, which lay flat across the instrument interior, are sectionalized into individual circuits. All components in a section are numbered within a series to identify the section within the assembly. Table 3-1 contains the series identification numbers and their corresponding section titles. A component number A2 R15 identifies resistor R15 in the Digital Controller section of the A2 Digital PCB Assembly. Other examples are: A2 U108 is IC U108 in the Remote Interface section of the Digital Assembly, A3 BR702 would be bridge rectifier BR702 in the Power Supply section of the A3 Analog Assemlby. In many cases the PCB Assembly is identified by name rather than "A" number, but in those cases the component number holds true. Figure 3-1 shows the location placement of the four assemblies within the instrument and of the individual sections on the Digital and Analog Assemblies.

3-5. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

3-6. Figure 3-2 is a block diagram of the circuits within the 8522A. The path of signal flow through the blocks during each of the functions available with the instrument is described in subsequent paragraphs. The signal path varies for each function until the analog data is changed to digital in the A/D Converter. From that point on, the signal flow is the same for all functions.

3-7. DC Volts

3-8. With DC Volts selected, an input between zero and 1000V dc can be applied to the Front Panel Input Terminals and applied to the I/O Switching Circuit. In the 100 and 1000 volt ranges, the signal is divided by 64 to bring it within the ±6.5 volt limits of the DC Buffer. The DC Buffer filters the dc input at the selected speed, conditions it to the proper levels and outputs a varying signal, between zero and ±16.5 volts, proportional to the input signal. The proportional analog signal is converted to digital data. The signal flow for a dc voltage input is shown in Figure 3-3.

Table 3-1. Component Identification

SECTION TITLE	COMPONENT IDENTIFICATION
Digital PCB	A2
Digital Controller	XX
IEEE Interface	1XX
Power Supply	2XX
Analog PCB	A3
I/O Switching	1XX
DC Buffer	2XX
Ohms Converter	3XX
AC Converter	4XX
A/D Converter	5XX
Analog Controller	6XX
Power Supply	7XX

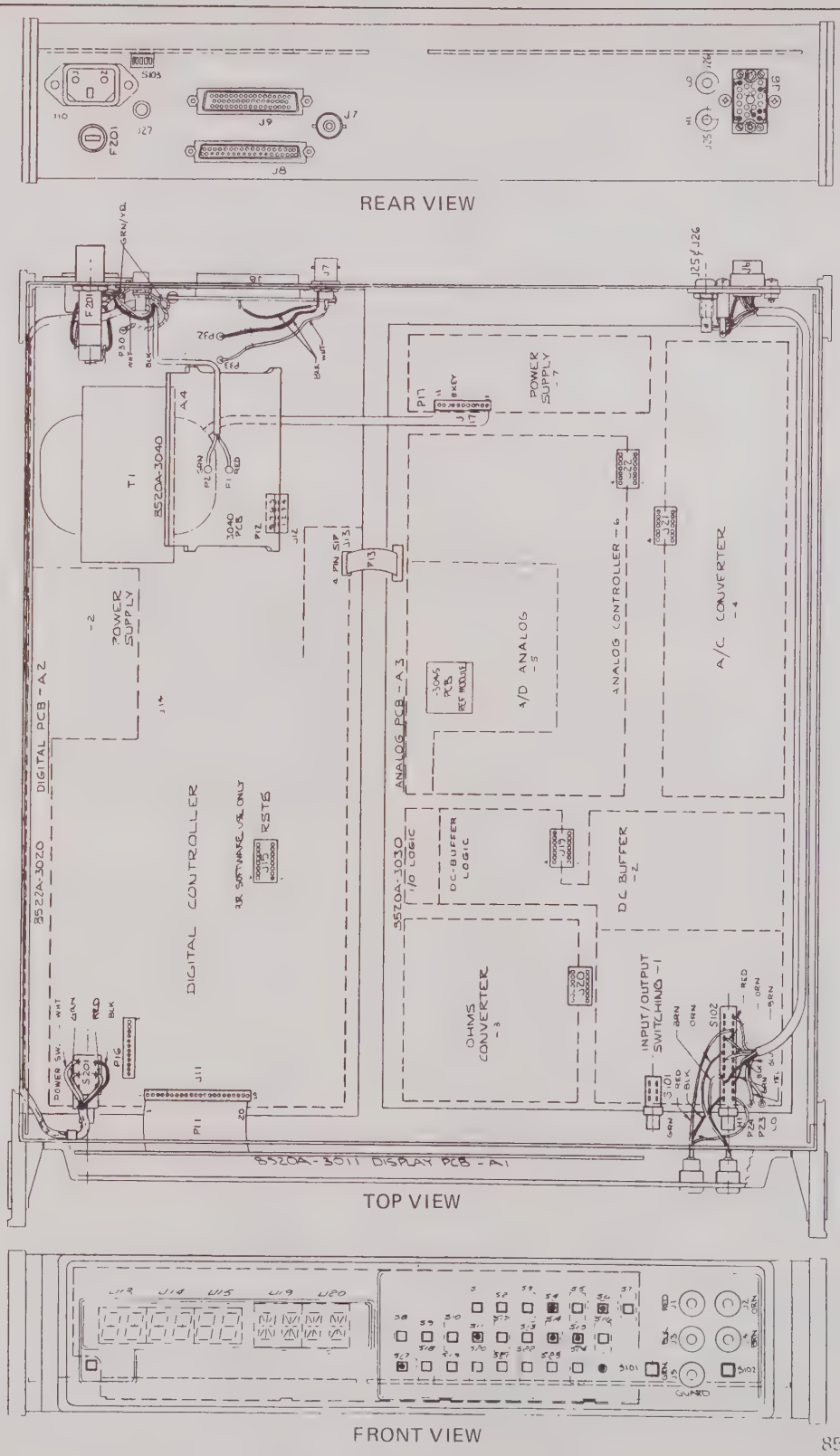


Figure 3-1. Assembly Placement

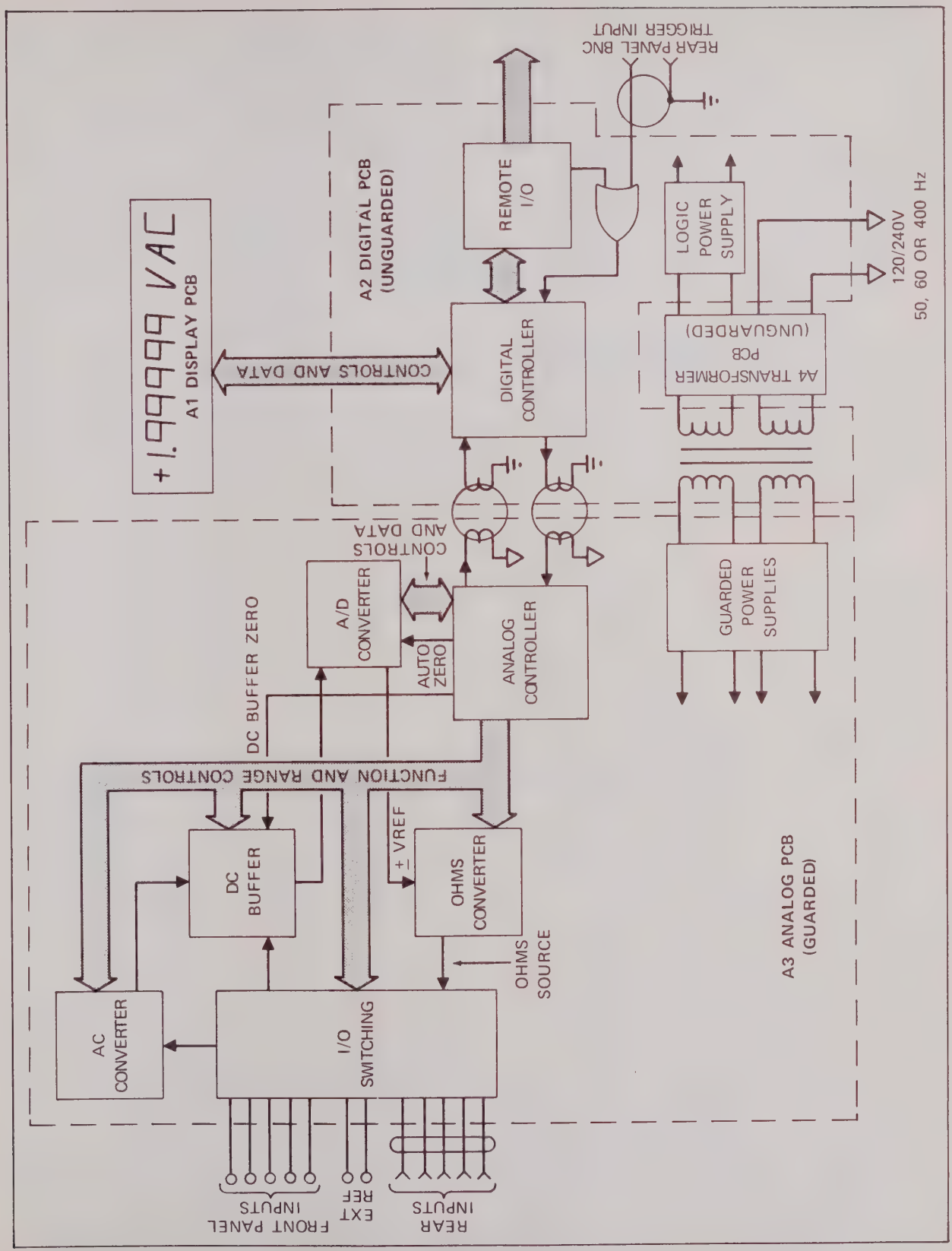


Figure 3-2. 8522A Block Diagram

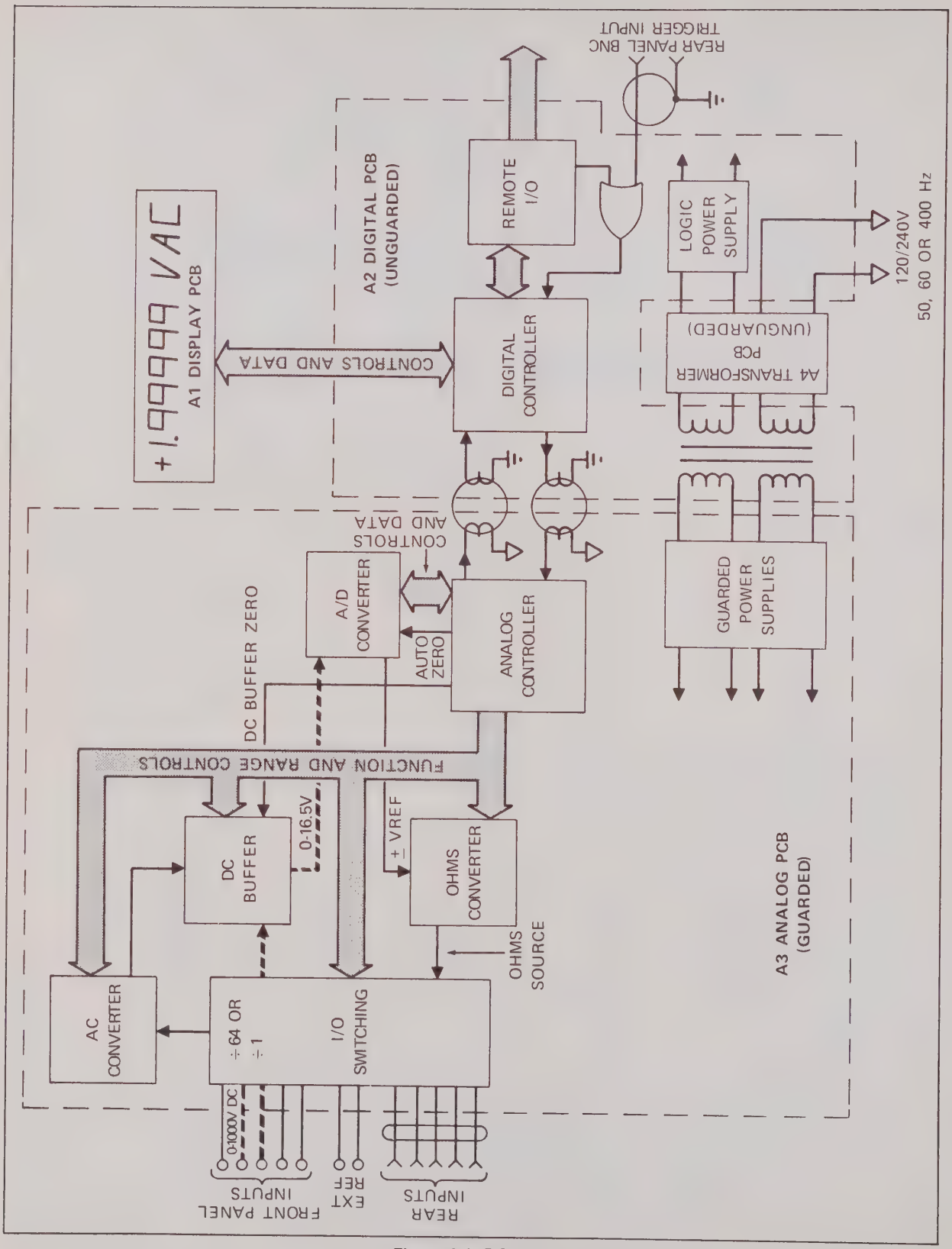


Figure 3-3. DC Volts

3-9. AC and AC + DC Volts

3-10. Figure 3-4 shows the signal path when either AC volts or AC + DC volts are selected. The maximum 650V rms or 1000V peak signal is input to the I/O Switching ciruit from the input terminals, but is routed directly to the AC Converter without change. Coupling into the AC Converter varies with the function selected, either through a capacitor for ac or around the capacitor for direct coupling for AC + DC. The AC Converter changes the zero to 650V ac input to a zero to 16.5V dc proportional signal and applies it to the DC Buffer. The DC Buffer treats the input just as it did the dc input, filtering, conditioning, and applying it to the A/D Converter for conversion to a digital signal.

3-11. Ohms and Nanosiemens

3-12. A resistance measurement is input to the I/O Switching section and then routed without change to the applicable portion of the Ohms Converter, low or high ohms. Measurements are made using a current reference for values of 19.9999 kilohms or less (LO OHMS) or a voltage reference and the ratio technique for values of 20 kilohms or greater (HI OHMS). The resulting voltage drop is proportional to the value of the measured resistance and is routed to the DC Buffer, through the I/O Switching section, and to the A/D Converter for conversion to digital data. Conductance measurements in nanosiemens are treated as a high ohms measurement and then inverted to obtain the reciprocal of the value. Figure 3-5 has the signal flow highlighted for a resistance operation.

3-13. External Reference

3-14. Signal flow for an external reference measurement is shown in Figure 3-6. External reference differs from a dc measurement only in the input of the external reference on the rear panel terminals. The input and the reference are multiplexed in the I/O Switching section, and the resultant voltages are sent alternately to the DC Buffer to be conditioned and to the A/D Converter to be changed to digital data. The actual computation of ratio is performed on the two A/D outputs by the Digital Controller.

3-15. External Trigger Inputs

3-16. External triggers may orginate in one of three different locations as shown in Figure 3-7. These are from the Front Panel MANUAL keyswitch, the rear panel BNC connector if enabled, and the Remote Interface. Once in the Digital Controller, trigger action does not vary between the external triggers and the internal trigger.

3-17. Digital Data Flow

3-18. Data is converted to a digital format in the A/D Converter which operates in combination with the Analog Controller. Switching signals for control of the analog functions are sent from the Digital Controller to the Analog Controller which latches the information and sends it to the applicable section. A/D Converter outputs are sent over the guard crossing to the Digital Controller and then processed as required for display or transmission over the Remote Bus.

3-19. DETAILED DESCRIPTION

3-20. A description of each operational section in the block diagram is given in the paragraphs below. The Power Supply circuits are described first, followed by the Display, Digital, and Analog Assemblies. The Power Supply has portions of its circuitry on both the Analog and Digital Assemblies, as well as on the Transformer Assembly. Refer to the schematic listed after the paragraph title during the discussion of the circuit.

3-21. Power Supply (8522A-1023)

3-22. The Power Supply schematic is a combination drawing including components located on the Digital Assembly (A2), the Analog Assembly (A3), the Transformer Assembly (A4), the front and rear panels, and transformer T201. Input line voltage is routed to the transformer primary through the front panel power switch and the line voltage selection switches on the Transformer Assembly.

3-23. Two secondary windings go to the analog assembly for the guarded power supplies. One secondary goes to the regulator through the rectifiers CR703 and CR704 to provide the +5 volts for the logic circuits. This is accomplished by tying -15 volts to logic high which puts logic common at -20 volts with respect to analog common. The other secondary is rectified by the bridge network BR701 for ±5 volt outputs from regulators U705 (+15V) and U706 (-15V). Another tap from the same secondary is rectified in BR702 for ±7 volt outputs from U704 (+27V) and U707 (-27V).

3-24. On the Digital Assembly, the regulator U202 takes the rectified output from CR1 and CR2 on the transformer assembly and, with its associated components, provides the unguarded +5V operating voltage for the logic circuits. The unregulated +5 volt output and its return are sent to the display assembly for use there. Another use for the secondary is 5V XFMR SEC which monitors line frequency. R210, in parallel with U202, provides an increased load capability. Test jumper J201 disconnects the supply, R210, and the load, so that the supply can be checked without a load.

3-25. Display Assembly (8522A-1011)

3-26. Segment control data from the controller is placed in U9 and U12 alternately and applied to the display in parallel through the segment drivers (U10/U11 and U23/U24). The driver outputs are multiplexed for the applicable character. The comman cathodes of the display are latched into U1 by the Controller with U2 and U3 acting as the digit drivers. One character from the numeric display (7 segment LEDs) and one-half of one

character from the alphanumeric display (14 segment LEDs) are addressed simultaneously. The display can be totally blanked with the DISPBLANK signal to prevent damage to the display. DISPBLANK originates on the Digital Controller and is generated if the switch matrix is not read at least once every 16 ms.

3-27. The switch matrix rows and the display are enabled at the same time. Depression of a switch gives a column signal. Decoding the row/column combination in the Controller identifies the depressed switch for the program.

3-28. The normal sequence for a display assembly operation begins with the clearing of U1 to prevent ghosting on the display. Data for the first numeric and one-half alphanumeric characters are then sent to U9 and U12 respectively and the display is turned on for 2 ms from U1. The process is repeated, stepping through the eight possible displays and turning on each indicator pair in turn at a 60 times per second refresh rate.

3-29. Digital Assembly

3-30. The digital assembly is divided into three separate sections. The Digital Controller and Remote Interface are individually covered in subsequent paragraphs. The third section, the Unguarded power Supply was covered previously as part of the composite Power Supply description.

3-31. DIGITAL CONTROLLER (8522A-1020)

3-32. The digital controller section contains the microprocessor, the ROM with the operating program, the RAM for temporary storage and burst memory, and the various control circuits. Each of these circuits is detailed in sub-paragraphs below.

3-33. Clock Circuit

3-34. The microprocessor and the Remote Interface are provided with a 4 MHz square wave by the clock circuit. Crystal Y1 is an 8 MHz oscillator that clocks the standard binary counter, U20. Outputs from the counter in addition to the 4 MHz, are 1 MHz and 2 MHz for use in the Guard Crossing circuitry. The parallel inverters at U19-10 and U19-12, with R6, keep the rise and fall time of the clock within specifications. Ringing is kept withing acceptable levels by R7.

3-35. Microprocessor

3-36. The microprocessor is a single component with fully decoded and timed output signals to control standard memory or peipheral circuits. Supply voltage for the device is +5V dc and the only clock required is a single-phase, 5V, 4 MHz square wave.

3-37. The internal register configuration of the microprocessor contains 208 bits of Read/Write memory accessible to the program. The registers include two sets of general purpose accumulator and flag registers that may be used as four 16-bit pairs or as eight 8-bit individuals. Also included is a 16-bit stack pointer that allows implementation of multiple level interrupts and unlimited subroutine nesting. Tabular data manipulation and relocatable code implementation is accomplished with the two 16-bit index registers. The Memory Refresh register provides automatic transparent refresh of external dynamic memories. The interrupt vector register forms the upper 8-bits of a pointer to an interrupt service address table during the interrupt response mode, while the lower 8-bits of the pointer are supplied by the interrupting device. An indirect call is made then to the service address formed. The last register is a 16-bit program counter.

3-38. Reset

3-39. The instrument circuitry is automatically reset at power up. When one shot U36-12 is not triggered, it provides U22-13 and 12 with a high and low signal respectively to provide a reset to the controller assembly. Line voltage (FLINE) input from U23-11 (divided by 7 at U32-13 if the line frequency is 400 Hz) triggers U36, releasing the counter U28, which in turn clocks U22 on a count of eight to remove the reset. This places the reset on the circuit for a predetermined time during power up.

3-40. When power is removed, U36-12 times out and sets U22 to apply a reset to the circuitry. Resistor R19 and capacitor C29 provide a timeout for resetting the instrument by shorting test points TP9 and TP10 together.

3-41. Wait

3-42. A WAIT signal is input to the microprocessor at U18-24 to indicate that the addressed memory needs an extended bus cycle. It is generated by U9 as the result of an M1 output from the microprocessor. M1 is active when the microprocessor is performing an op code fetch cycle. The M1 memory access is shorter than all other cycles, in order to provide for the refresh cycle (not used). One WAIT state is added to allow for the access time of the ROMs.

3-43. Interrupt

3-44. There are three sources of interrupts. These are: the Remote Interface circuit, the guard crossing circuit, and the phase locked loop circuit. The interrupt signals are combined in a wired OR circuit for an input to the microprocessor at U18-16. R26 is a passive pull-up for the line and, in conjunction with C31, filters high frequency chassis noise (>10 MHz) to prevent spurious interrupts. U17-4 in the OR circuit is active (low) from an interrupt from the Remote Interface. The UART data available output is connected to the interrupt line via U33-2, which is enabled at U33-1 from U8-15, and U17-11. Line synchronous interrupts (MARK) are generated by U17-6 each time the phase-locked loop output has a positive transition. The MARK is enabled and cleared by signal MARK EN at U35-1 from U8-19.

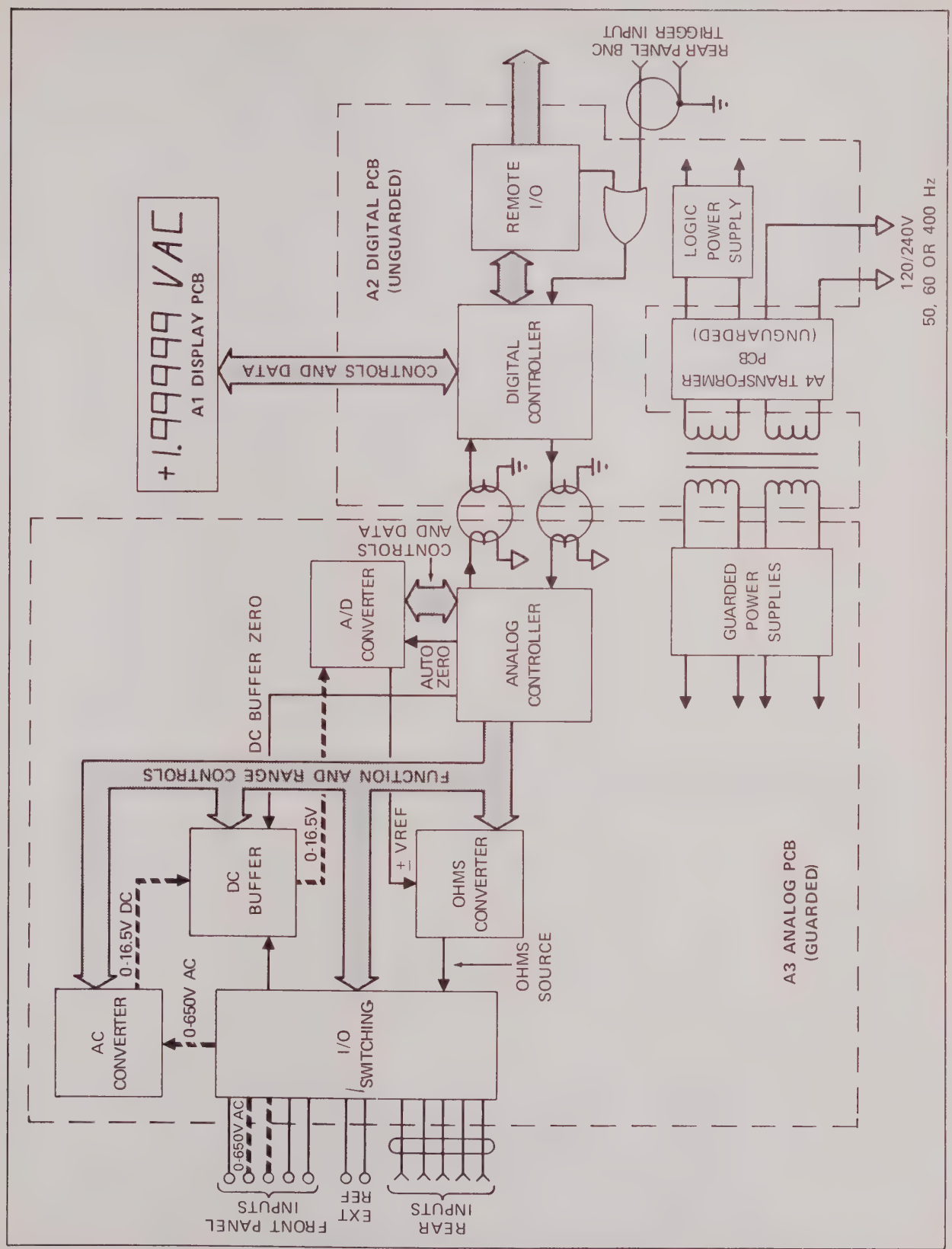


Figure 3-4. AC Volts and AC + DC Volts

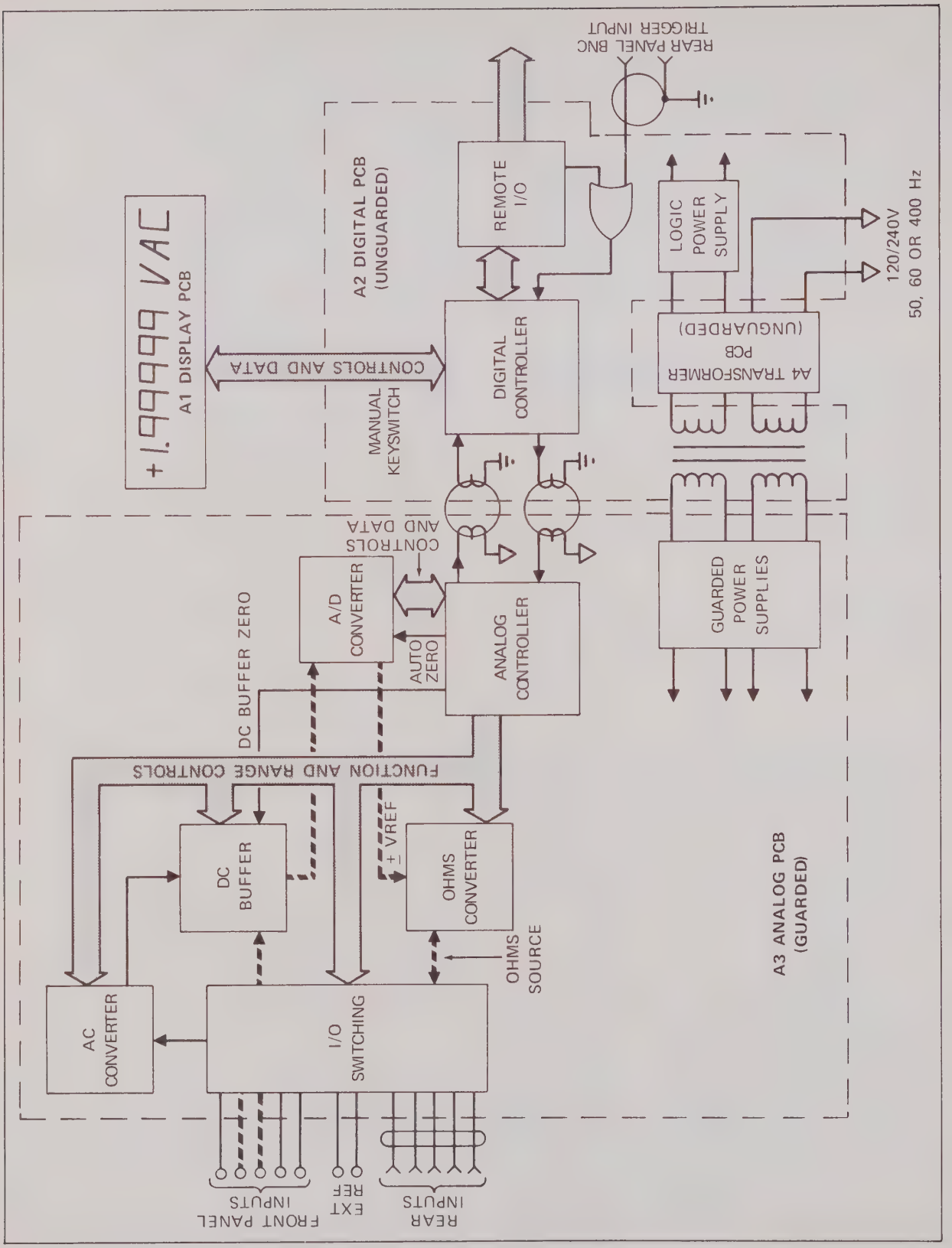


Figure 3-5. Ohms and Nanosiemens

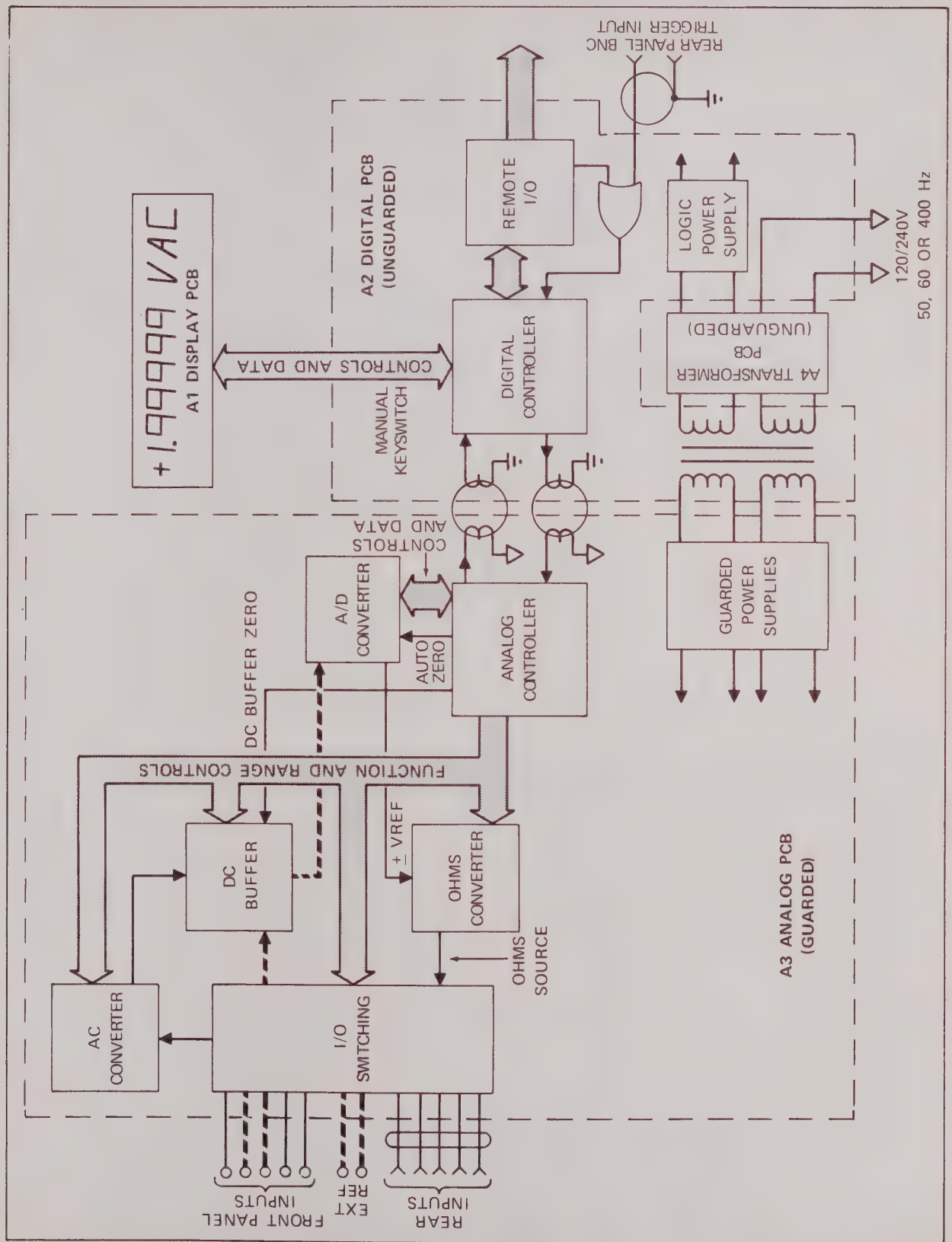


Figure 3-6. External Reference DC Volts

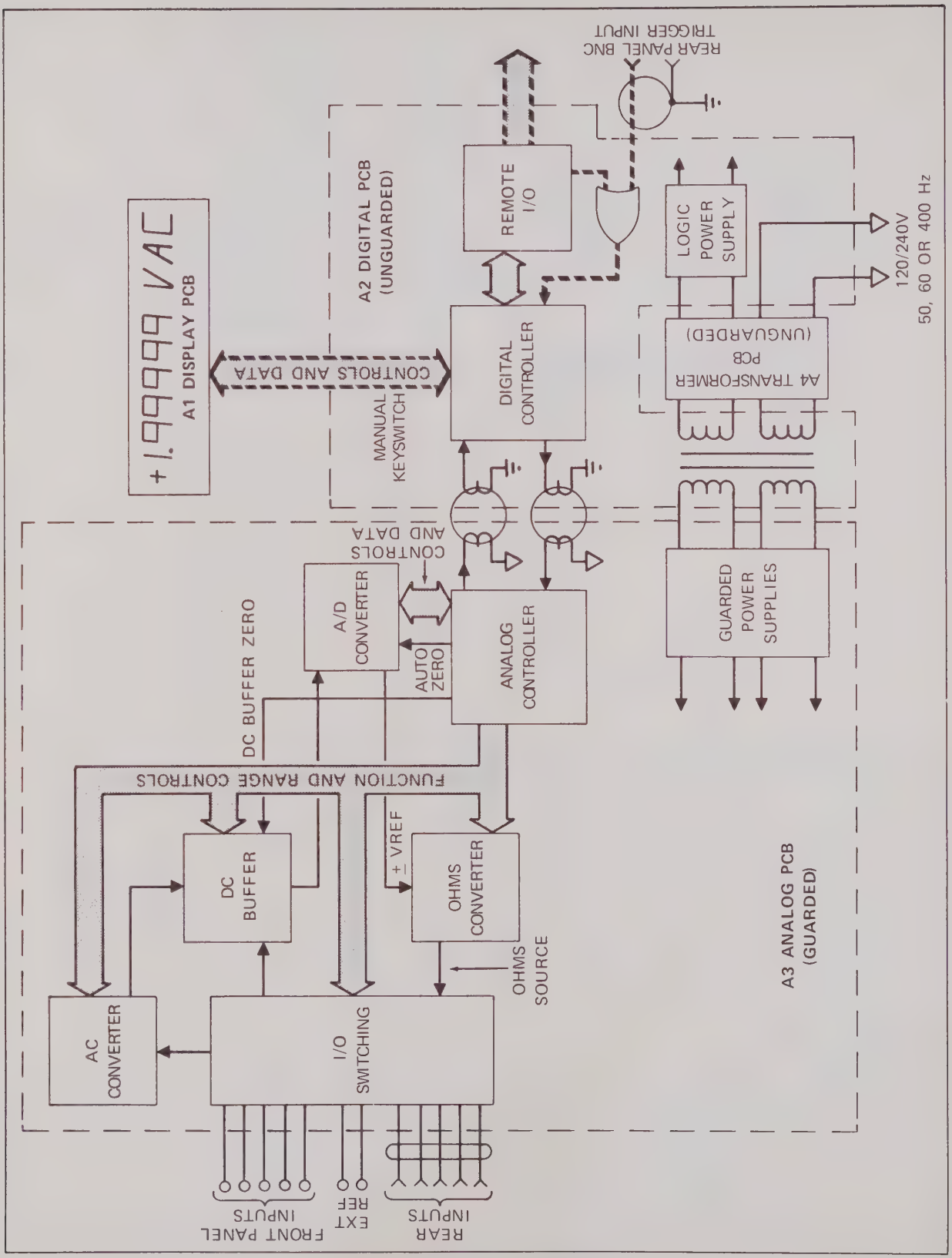


Figure 3-7. External Trigger Inputs

3-45. Phase-Locked Loop

3-46. Digital noise rejection is accomplished by averaging line synchronous samples. A/D samples are synchronized to the AC line by the phase-locked loop (PLL). The line frequency input (U29-14) is multiplied by 8 by the PLL circuitry U29 and U28. The PLL output (U29-4) which is eight times the input frequency (8/7 for 400 Hz line) provides a clock for MARK interrupts (U35-3), display blanking U21-1), and the guard crossing trigger flip flop (U1-3).

3-47. Guard Crossing

3-48. The Guard Crossing transfers data between the Digital and Analog Controllers using very similar circuits on each assembly. On the digital controller it consists of the UART U26, the one-shot U36, the pulse transformer U38, and gates from U37 and U30, and their associated components. The UART converts the eight bits of parallel data received on the bus (U26-26 through 33) into a serial data stream, adding parity, start, and stop bits. The 125k baud serial data from U26-25 is inverted (U30-6) to modulate the 2 MHz signal from U20-13. The high voltage driver U37-5 then sends the signal through the pulse transformer U38-3 to the guarded analog controller.

3-49. Modulated 2 MHz data from the analog controller is received by the pulse transformer. Components Q1, R25, and R27 apply the 2 MHz data to the one-shot input, U36-2, independent of variations in Vcc. The one-shot U36 stretches the 2 MHz bursts into a digital series stream of the original 125 kilo baud rate. The UART converts it to a parallel format and outputs it to the bus on U26-5 through 12.

3-50. Memory Select

3-51. The memory for the digital controller consists of two RAMs (four with Option -010), three ROMs, on EPROM, and their control circuits U2, U3, U30, and U34. Address line A15 from the microprocessor enables either RAM or ROM EPROM. If it is high, RAM is addressed, if low, ROM/EPROM is addressed. When MEMREQ is low, both RAM and ROM/EPROM are enabled.

3-52. When RAM is addressed A10, A11, and A12 select either the standard memory (U6 and U7) or the optional memory (U4 and U5) with A10 low and high, respectively.

3-53. One of the three ROMs (U10, U11, and U12) is enabled by U3 from the decoded A13 and A14 signals. Control circuits U3, U30, and U34 enable EPROM U13 by decoding A12, A3, and A14. U14 is not installed; its socket is left open for special applications or future expansion.

3-54. Display Blank

3-55. The phase locked-loop clocks U21-1 to count toward eight. If it reaches that count without being reset by the SW signal from U25-8, U21-6 goes high and blanks the front panel display.

3-56. Guard Crossing Trigger

3-57. A short pulse is generated in this circuit for the Analog Controller. It is generated at U21-11 and sent through U37-3 to the pulse transformer (U38-6).

3-58. Sources of the trigger are: the external trigger from either the rear panel (U23-2) or the Remote Interface (U23-2), the MARK trigger U8-6, or the software trigger at U33-13 from the decoded address at U25-10.

3-59. External Trigger

3-60. The external trigger edge is selected by the Schmitt trigger circuit at U39 and S103. If the instrument is in the parallel mode (remote), the external trigger is applied at the BNC connector located on the rear panel. If the instrument is in the BCD mode (remote), the external trigger is applied at J8-15 located on the rear panel. The minimum width for an external trigger is 360 us (see Figure 3-8). If the External Trigger line is low when the External Trigger Inhibit line is changed from high to low, a reading will be triggered. The external trigger clocks U35-11, if enabled by EXT TRIG EN at U35-13 from U8-16.

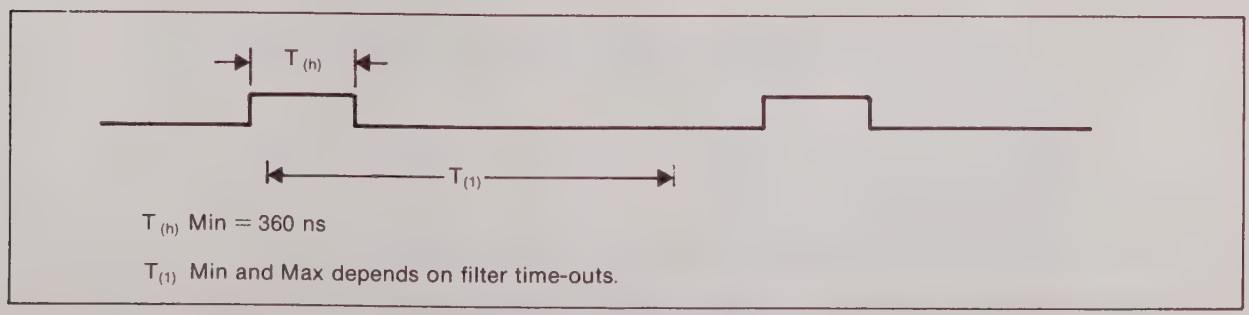


Figure 3-8. External Trigger Timing

3-61. REMOTE INTERFACE (8522A-1021)

3-62. The remote interface operates in one of two distinct operating modes, BCD or Parallel. The operating mode is selected by a switch on the rear panel. The Parallel mode is further subdivided, according to handshaking methods. The 4-wire handshake (compatible with the Fluke 1720A-002 Interface or the DR11-C Interface (used in PCP11 computer family) or into 3-wire handshake (compatible with the HP 98032 option for the 9825 and other desktop computers) is also selected by a switch on the rear panel. See Figure 3-9 (a, b, c, d) for handshake diagrams and timing specifications, and Table 3-2 for remote interface electrical specifications. See Figure 3-10 for BCD external signal timing diagrams.

a. 8522A checks for Data Transmitted equal to a logic low.

b. 8522A puts data on lines Bit 0-15 Out (8-15 for 8-bit mode).

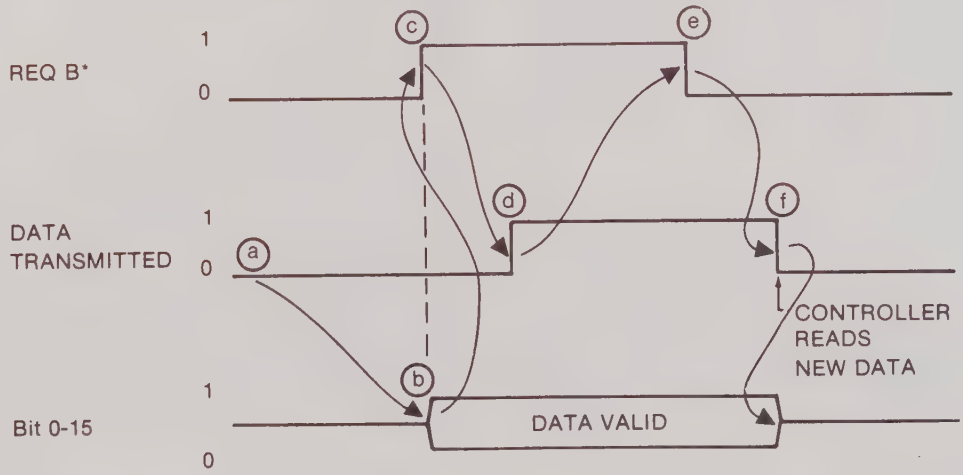
c. 8522A toggles Req B to logic high, to indicate output data valid.

d. Remote controller sets Data Transmitted high.

e. 8522A resets Req B to low.

f. Controller resets Data Transmitted low.

g. The process is repeated until all data has been transferred.



*In the 4-wire parallel mode, the 4-wire controller must poll Req B to determine when data from the 8522A is valid.

NOTES:

1. T_c to T_d = 175ns Max
2. T_c to T_e = 120ns Min
3. For open collector drivers as external source, add 305 ns to (1) and (2).

Figure 3-9A. Four-wire Data from 8522A

a. Remote controller checks to see if Req A is at a logic high.

b. Controller puts data on lines Bit 0-15 In (8-15 for 8-bit mode)

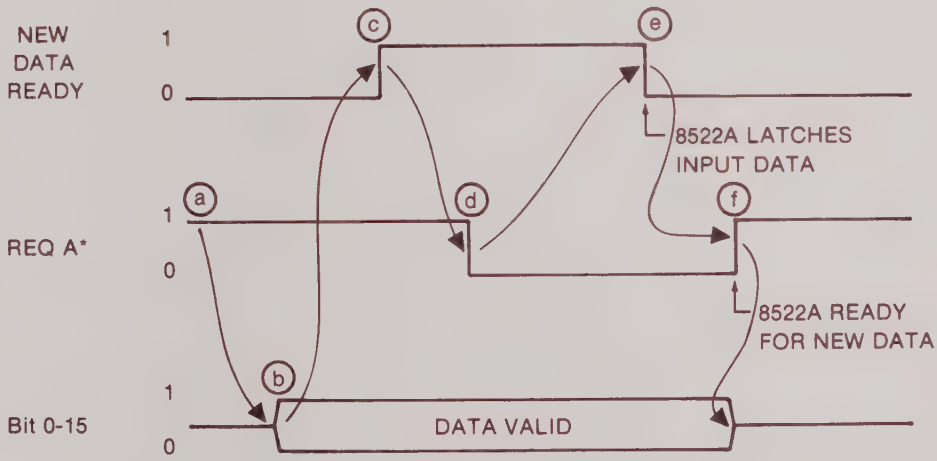
c. Controller toggles New Data Ready from low to high.

d. 8522A toggles Req A from high to low.

e. Controller resets New Data Ready to a logic low, which causes the 8522A to latch (store) the data.

f. 8522A sets Req A high, indicating a ready for the next transfer.

g. The process is repeated until the complete command string has been sent.



*In the 4-wire parallel mode, the 4-wire controller must poll Req A to determine when the 8522A is ready for more input.

NOTES:

1. T_c to T_e = 120ns Min
2. T_c to T_d = 200ns Max
3. For open collector drivers as external source, add 305 ns to (1) and (2).

Figure 3-9B. Four-wire Data to 8522A

a. Controller checks to see if PFLG is at a logic high (ready).

b. Controller sets I/O signal to a logic low.

c. Controller puts data on lines Bit 0-15 In (8-15 for 8-bit mode).

d. Controller toggles PCTL signal from low (clear) to high (set).

e. 8522A acknowledges by bringing PFLG low (busy).

f. Controller drops PCTL to logic low causing the 8522A to latch transfer data.

g. When the 8522A is ready to accept more information PFLG goes high.

h. The process is repeated until the remote controller has sent a full command string.

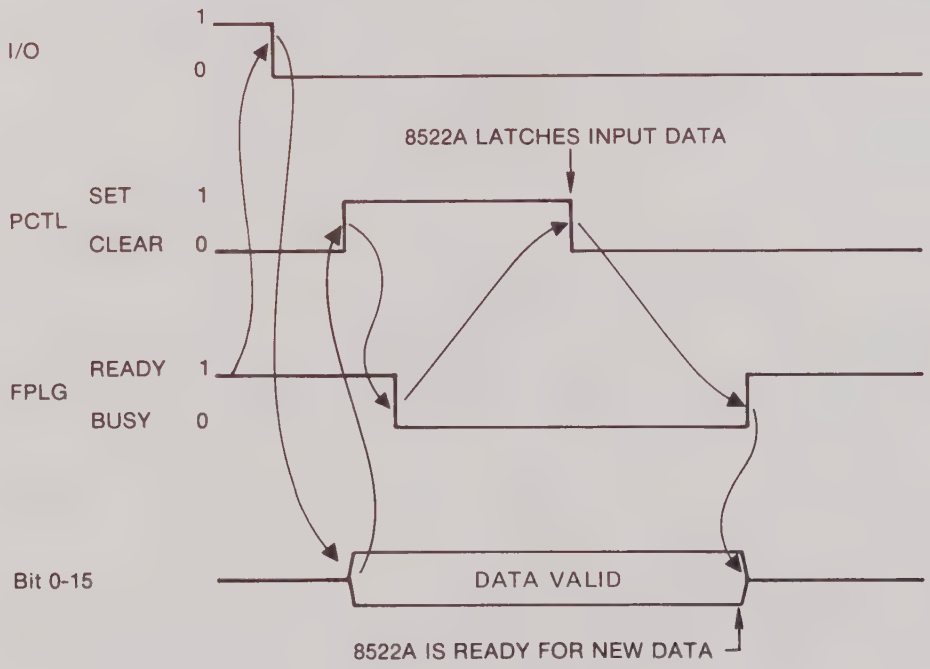


Figure 3-9C. Three-wire Data to 8522A

a. Remote controller checks to see if PFLG is at a logic high (ready).

b. Controller sets I/O signal high.

c. Controller toggles PCTL from a logic low (clear) to a logic high (set).

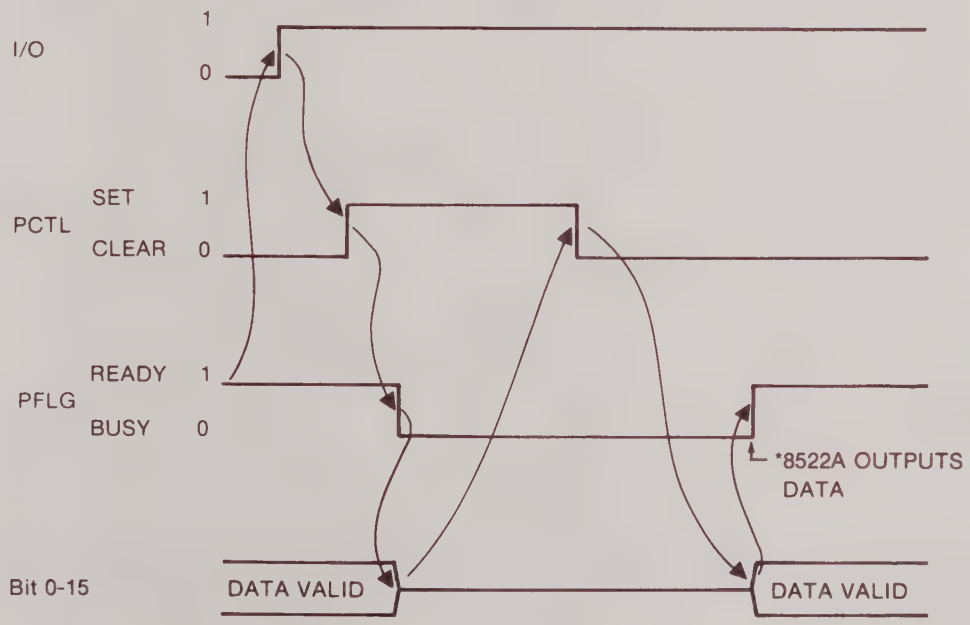
d. 8522A acknowledges by resetting PFLG to a logic low (busy).

e. Controller resets PCTL.

f. 8522A puts data on lines Bit 0-15 Out (8-15 for 8-bit mode).

g. 8522A returns PFLG to logic high.

h. The process is repeated until the remote controller has received all data requested, e.g., a full reading, status, etc.



*In the 3-wire parallel mode, the 8522A sets PFLG ready when it is ready to respond to the controller. When output is requested PFLG remains in the Busy state until output is valid, or until a leading-edge transition of the PRESET input occurs.

Figure 3-9D. Three-wire Data From 8522A

Table 3-2. Remote Interface Electrical Specifications

Current polarity designation is + for currents coming into the 8522A and — for currents going out from the 8522A. Inputs may be driven with TTL, LSTTL, DTL, open collector (except the BNC trigger input), and other types of sources. For all outputs the maximum voltage for logic low is 0.4 volts and the minimum voltage for logic high is 2.4 volts.

COMMAND INPUTS

All command inputs have 10 kilohm pull-up resistors to +5 volts. No external source of current is needed to apply a logic high. Low level input current required, for Vi = 0.4 volts, is -0.88 mA on all command inputs except "POS".

$I_{(il)}$ = -0.88 mA Maximum

For "POS": $I_{(il)}$ = -0.68 mA Maximum

CONTROL

Inputs to 8522A:	Maximum input current
Ext. Command Entry (New Data Ready) (PCTL)	I (il) = -2.7 mA
$\overline{\text{Auto}}$ $\overline{\text{Command}}$ $\overline{\text{Defeat}}$	$I_{(il)}$ = -2.08 mA
Ext. Trig. (PCD mode)	$I_{(il)}$ = -0.88 mA
Data Transmitted	$I_{(il)}$ = -3.5 mA
$\overline{\text{In}}$/Out	$I_{(il)}$ = -0.88 mA
$\overline{\text{Ext.}}$ $\overline{\text{Trig.}}$ $\overline{\text{Inhibit}}$	$I_{(il)}$ = -0.88 mA
BNC external trig.	$I_{(il)}$ = -0.4 mA $I_{(ih)}$ = 20 uA

Outputs from 8522A:

	Maximum output current	
@Vo =	**low**	**high**
Req A	16 mA	-800 uA
Req B	16 mA	-800 uA
Flag	16 mA	-400 uA
PFLG	16 mA	-5.2 mA
$\overline{\text{PAR}}$ $\overline{\text{REM}}$	16 mA	-5.2 mA
PON	NA	-30 mA

DATA OUTPUT

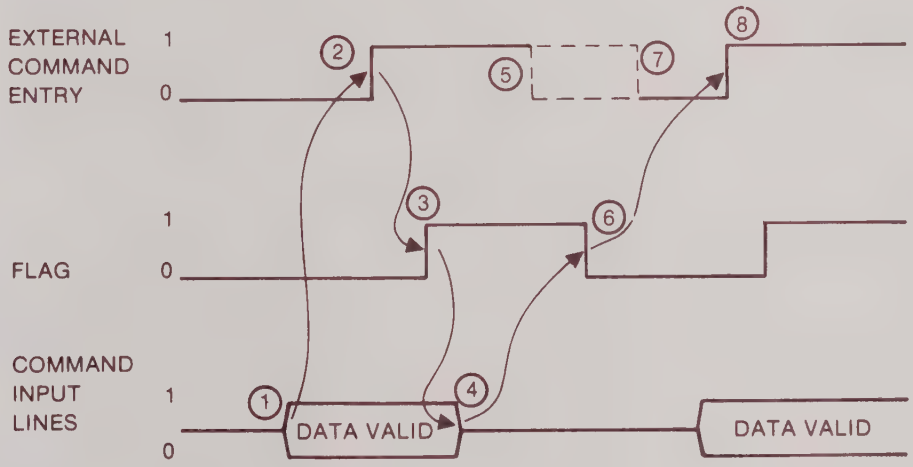
Maximum output currents for all data outputs (EXCEPT those listed below) are -2.6 mA for Vo high, and 16 mA for Vo low.
Also:

Vo =	**low**	**high**
Overrange	16 mA	-5.2 mA
Overload	16 mA	-5.2 mA
Trigger	16 mA	-5.2 mA
Busy	16 mA	-400 uA
Sample Sync	12 mA	-2.6 mA

The gates (G1,G2,G3,G4,G5,GOR,GPF,GSF,GOL) for the output data require input currents of 20 uA for high logic level and -0.4 mA for low.

3-63. With the 8522A in the BCD mode, the Fluke 8375A and 8400A BCD interfaces are emulated. Functions, ranges, filter on/off, external reference, and reading triggereing are available from the BCD interface. The reading rate is selected from the front panel, similar to the 8375A operation. Only external reference os the math and none of the burst capabilities are accessible from the BCD interface because only the 8375A capabilities are being emulated.

3-64. Full access to the 8522A capabilities is possible from the 8522A parallel interface. Either 8- or 16-bit words can be selected. The parallel commands are recieved in ASCII, one (or two) character(s) at a time over the 8(16) bit data lines. The parallel output data form is ASCII, 4 bytes binary, or 2 bytes binary; and is transmitted one (or two) bytes at a time over the 8(16) bit data lines. The 4-wire handshake has four signal lines, two sourced by the 8522A (Req A and Req B) and two sourced by the remote controller (Data Transmitted and New Data Ready). The New Data Ready and Req A signals are dedicated to transferring commands to the 8522A (see Figure 3-9b). The Data Transmitted and Req B signals are dedicated to transferring readings, status, and other data from the 8522A to the remote controller (see Figure 3-9a). One word (16 or 8 bits, selectable) is transferred each time an output or input handshake sequence occurs. The 3-wire handshake has three signal lines, one sourced by the 8522A (PFLG) and two sourced by the remote controller (PCTL) and IN/OUT) (see Figures 3-9c and 3-9d). The IN/OUT signal is set low by the remote controller when data is to be sent to the 8522A. PCTL gains the attention of the 8522A, and PFLG is the 8522A responce. For more datails on operation, see the 8522A Operator Manual.



Sequence:

1. Command sent. Allow time for data to settle.
2. Command inputs are latched at rising edge of External Command Entry.
3. Flag goes high (1) in response to External Command Entry.
4. Data on Command Input Lines may be changed at this time. External Command Entry may be returned low (0) at this time. However, External Command Entry may not be returned high (1) again before time (5).
5. The 8522A is ready for a new command to be entered.

NOTES:

1. T_2 to T_5 = 120 ns Min
2. T_2 to T_3 = 175 ns Max
3. T_2 to T_4 = 180 ns Min
4. T_7 to T_8 = 90 ns Min
5. For open collector drivers as external source, add 305 ns to (1) and (2).

Figure 3-10. BCD External Signal Timing Diagrams

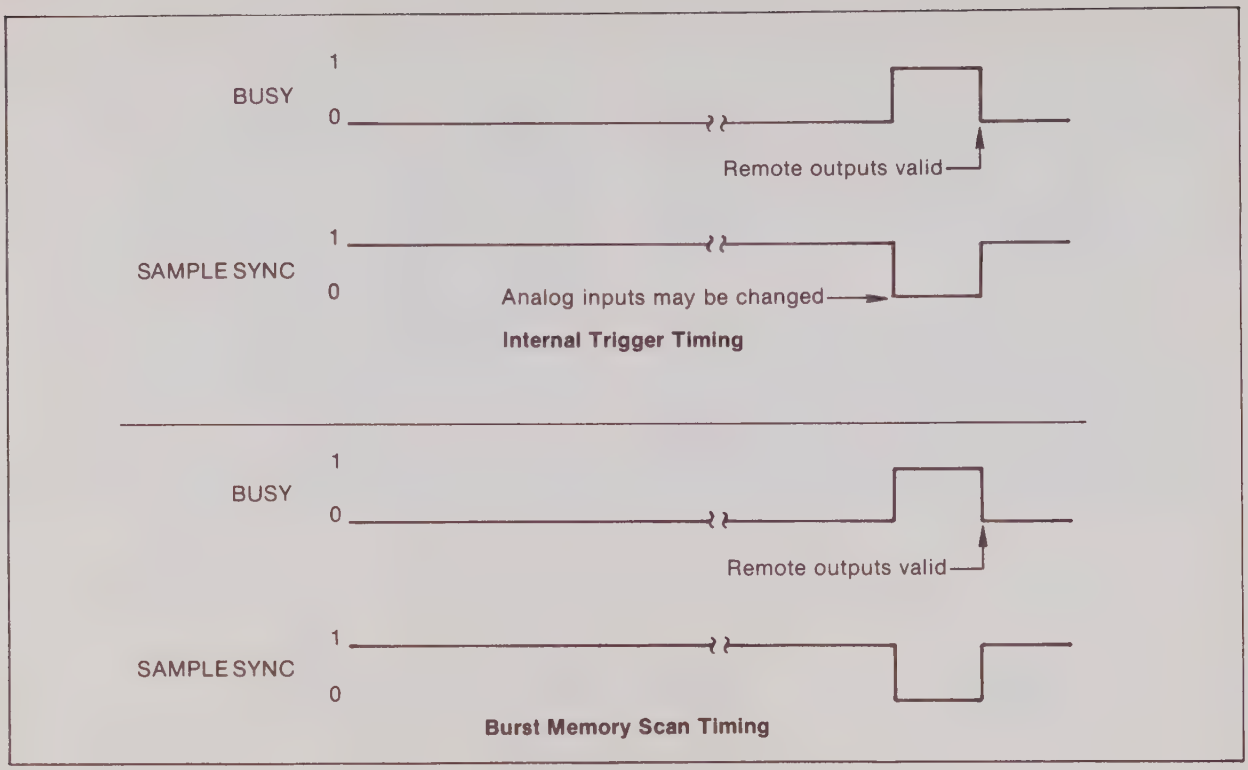


Figure 3-10. BCD External Signal Timing Diagrams (cont)

3-65. For discussion purposes, the hardware is subdivided into the following sections (see block diagram in Figure 3-11): 1) tristate latches for input and output registers, 2) control and status, 3) active switches, 4) handshaking, 5) interrupt handling, 6) bus buffer, 7) remote address acknowledge.

3-66. I/O Registers

3-67. The Z80 CPU addresses the remote interface registers as a set of ports. The distinction between parallel 3-wire, parallel 4-wire, and BCD use of I/O registers is made only in the software. All the input registers are quad D-flip flops and all the output registers are 4-bit D registers. When changing between the BCD and parallel operating modes, the connector pins and the register bits are redefined (see Table 3-3 for I/O signals).

3-68. There are sixteen bits of parallel and twelve bits of BCD command signals which are input simultaneously. These inputs are latched either by the handshaking signals or by Z80 CPU control depending on the operating mode. Some external signals are not latched. The BCD external input signal 'programmable one shot' is not latched (see Table 3-3) for I/O signals).

3-69. There are sixteen bits of parallel and thirty four bits of BCD latched output signals available to the user. All of these outputs may be put in a high impedance state (tristated) by external gate control signals (see Table 3-3 for I/O signals). External gating of the output signals allows the user to time multiplex the outputs onto a common bus, one group (usually of four signals) at a time. Two additional status signals 'busy' and 'sample sync' are available in BCD operation (see Figures 3-2 and 3-10).

3-70. Control and Status

3-71. The control hardware receives its directions from the Z80 CPU by decoding addresses and data bits written to certain I/O addresses. The control section initializes hardware, directs data flow onto and from the bus, and controls the handshaking section and active switches. The status of external signals, the switches S103, and the internal hardware is directed to the Z80 CPU.

3-72. Active Switches

3-73. Active switches direct the flow of trigger signals and the flow of input latching signals. In BCD operation, the external trigger input is available on the external connector (J8-J15) while in parallel operation, the BNC (J7) is used.

3-74. Handshaking

3-75. The handshaking circuitry is used to latch in input command signals and interrupt the Z80 CPU. Some of the external connector pins involved in the handshaking are redefined depending on the mode of remote operation (see Table 3-3 for I/O signals).

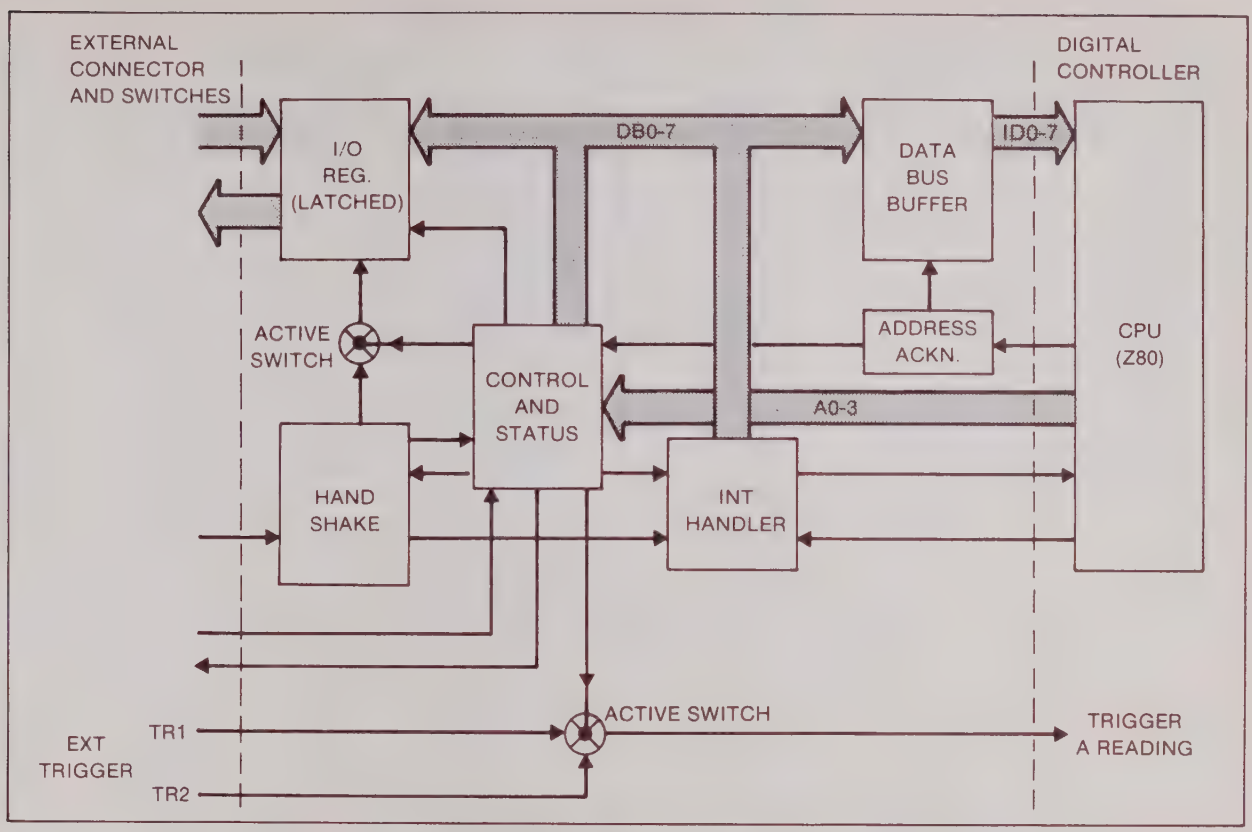


Figure 3-11. Block Diagram of Remote Circuit

3-76. Interrupt Handler

3-77. Interrupt handling circuitry implements the following functions: Provide an interrupt status vector. Provide control signal for the Z80 CPU to disable the interrupt signal.

3-78. Data Bus Buffer

3-79. The remote data bus buffer is enabled at the same time the bus buffer for the rest of the instrument is disabled. The buffers prevent excessive capacitive loading on the Z80 CPU data bus lines (ID0-7).

3-80. Remote Address Acknowledge

3-81. The remote address acknowledge circuitry enables the remote circuitry to respond to the CPU's signals (e.g. data bus, address, and control signals.) It allows the remote data bus buffer to remain enabled and in the correct transmission direction even after the "IOREQ" and "RD" signals change. This holding is necessary to provide a hold time for the inputs to the output registers after the rising edge of "IOREQ" causes the data to be latched into the output registers (see Figure 3-13 for timing diagram).

3-82. Figure 3-14 shows the specifications for the following timing diagrams. In general T(h) is the width of a pulse and T(l) is the time between pulses.

3-83. Analog Assembly

3-84. The Analog Assembly is divided into seven separate sections. Six are covered individually in subsequent paragraphs while the seventh, the Guarded Power Supply, was covered previously as part of the composite Power Supply.

3-85. I/O SWITCHING (8522A-1031)

3-86. Manual selection of input terminals and guard source, electrical selection of function, routing of signals, filtering, and multiplexing are performed in the I/O Switching section.

3-87. Switch S102 selects between the front panel input terminals and the rear panel connector. When the switch is out, the front panel terminals are connected through the switch to the internal circuitry. If the switch is depressed, the rear panel connector is used. The guard is controlled by S101. If S101 is pressed in, the front panel guard terminal, and therefore anything connected to it, is connected to the internal V guard. When S101 is out, (NORMAL) the V guard is connected through the switch to chassis ground, and the front panel guard terminal is open circuited.

Table 3-3. Remote Interface I/O Signals

COMMAND INPUT	
BCD	**Parallel 3&4-wire**
$\overline{\text{VAC}}$	D0
$\overline{\text{Ohm}}$	D1
$\overline{\text{KOhm}}$	D2
$\overline{\text{.1 Range}}$	D3
$\overline{\text{1 Range}}$	D4
$\overline{\text{10 Range}}$	D5
$\overline{\text{100 Range}}$	D6
$\overline{\text{1000 Range}}$	D7
$\overline{\text{10K Range}}$	D8
$\overline{\text{Filter}}$	D9
$\overline{\text{External Reference}}$	D10
Programmable One Shot	D11
	D12
	D13
	D14
	D15

CONTROL		
BCD	**4-wire**	**3-wire**
Ext. Command Entry	New Data Ready	PCTL
$\overline{\text{Auto}}$ $\overline{\text{Command}}$ $\overline{\text{Defeat}}$	Req B	PFLG
Ext. Trig.	Data Transmitted	$\overline{\text{IN}}$/OUT
$\overline{\text{Ext. Trig. Inhibit}}$	Req A	PRESET
Flag	$\overline{\text{PAR}}$ $\overline{\text{REM}}$	$\overline{\text{PAR}}$ $\overline{\text{REM}}$
PON		

DATA OUTPUT	
BCD	**Parallel 3&4-wire**
Range (coded) b	D0
Range (coded) c	D1
Range (coded) d	D2
GR (gate)	D3
Overrange	D4
GOR (gate)	D5
1st Decade 8	D6
1st Decade 4	D7
1st Decade 2	D8
1st Decade 1	D9
G1 (gate)	D10
2nd Decade 8	D11
2nd Decade 4	D12
2nd Decade 2	D13
2nd Decade 1	D14
G2 (gate)	D15
3rd Decade 8	
3rd Decade 4	
3rd Decade 2	
3rd Decade 1	
G3 (gate)	
4th Decade 8	
4th Decade 4	
4th Decade 2	
4th Decade 1	
G4 (gate)	
5th Decade 8	
5th Decade 4	
5th Decade 2	
5th Decade 1	
G5 (gate)	
VDC	
VAC	
Ohm	
KOhm	
GPF (gate)	
Polarity	
Filter	
Ext. Ref.	
Remote	
GSF (gate)	
Overload	
Trigger	
GOL (gate)	
Busy (status)	
Sample Sync (status)	

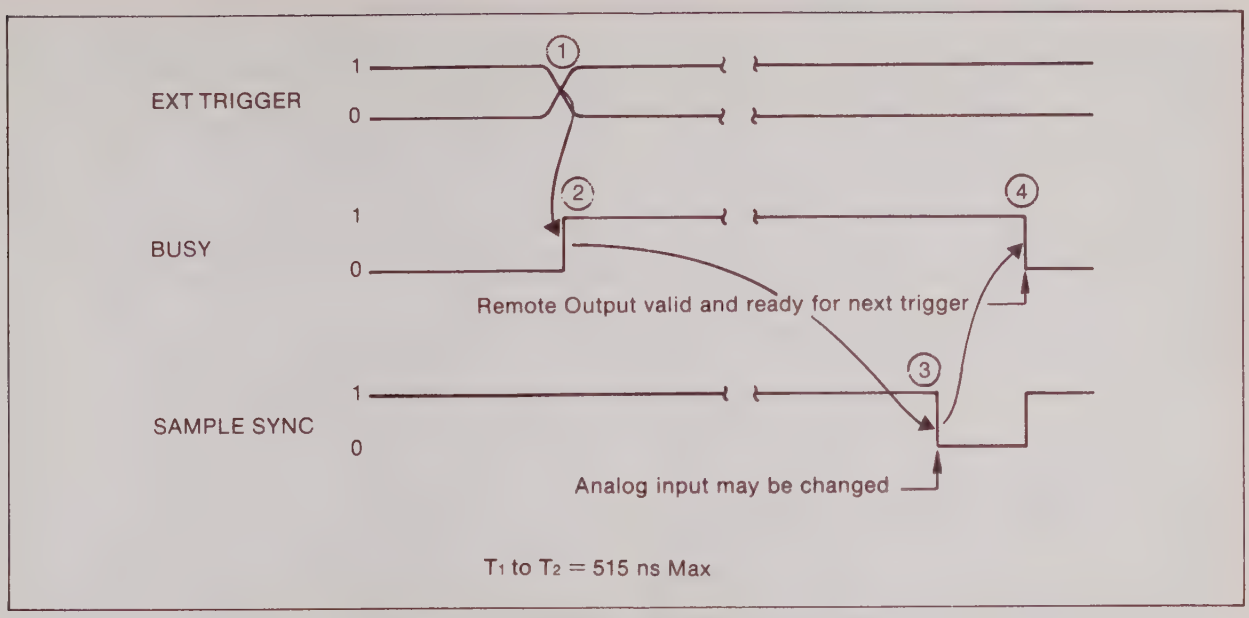


Figure 3-12. External Trigger Timing for BCD

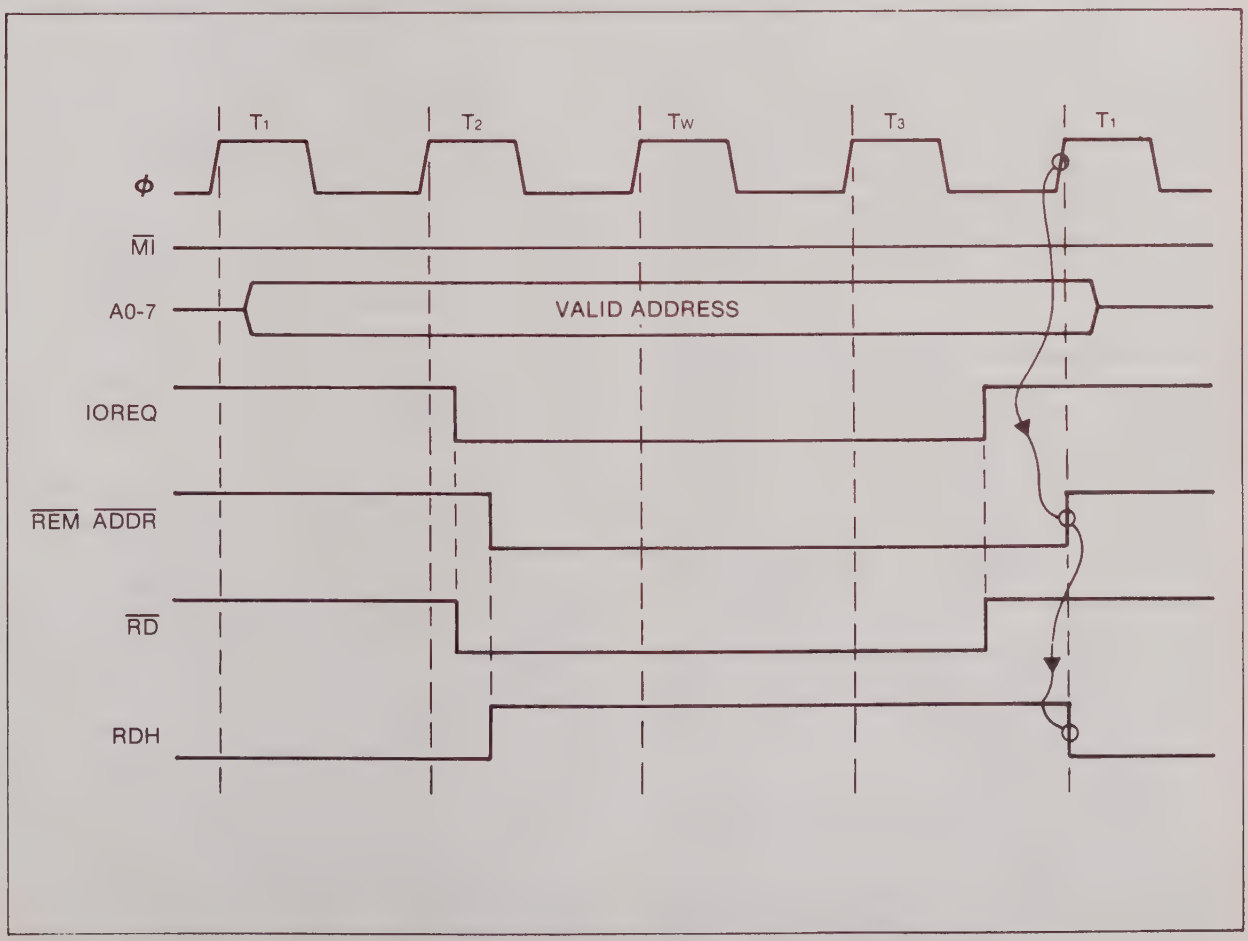


Figure 3-13. Remote Acknowledge Timing

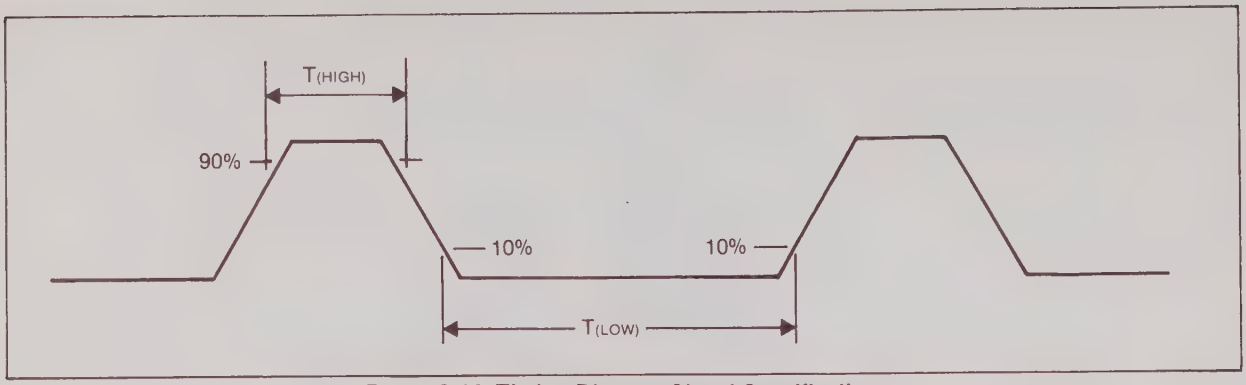


Figure 3-14. Timing Diagram Signal Specifications

3-88. After selection at S102, the input signal is routed through the contacts of K103. For all functions except low ohms K103 is de-energized, and the signal is routed to other circuits for further direction. In low ohms (K103 energized) the signal is routed directly to the Ohms Converter. K101 is energized in the 2-terminal ohms function to connect the input terminals to the sense terminals.

3-89. AC or AC + DC measurements are routed to the AC Converter through the energized contacts of K104. Relay K102 is energized for the 100 mV and 10V dc ranges, passing through the 150 kΩ current limiting resistor R110 on its path to the DC Buffer. For the 100V and 1000V ranges, the signal is divided by a factor of 64 in R107. With the high input impedance of the DC Buffer, energizing the relay (K102) does not cause any attenuation.

3-90. High voltage transients in excess of 1.6 kV are clamped by R104 and RV101 through RV104. Thermister R103 and RV105 provide high voltage protection between guard and chassis. The transistors Q101 and Q102, and the diodes CR107 and CR108 limit the input to the multiplexer stage to ±8.7 volts.

3-91. Digital signals into the multiplexer stage from the A/D Converter are translated into –27V for a logic high and open for logic low (by U103, U102, and Q110), to operate the applicable FET switch from Q103 through Q108. An open input to the FET gate turns the switch "on" and allows the applicable input signal to pass through to the DC Buffer section.

3-92. DC BUFFER (8522A-1032)

3-93. The DC Buffer section accepts the data input from the I/O Switching section, filters it at the selected speed, and conditions the signal to the proper levels for the A/D Converter. The eventual input to the A/D Converter will be a chopped dc signal, varying between zero and ±6.5 volts, and proportional to the input signal.

3-94. Filter Circuit

3-95. The filtering stage consists of a fast filter which is a single pole RC network and a slow filter which is a three pole active filter. The settling time is determined by the filter selected, which also controls the number of samples averaged. The Analog Controller selects the slow filter on power intitialization and switches automatically with the reading rate. Table 3-4 gives the settling time, number of samples, and reading rate for each filter.

Table 3-4. Filter Settings

FILTER	SETTLING TIME	NO. OF SAMPLES AVERAGED	READING RATE
Fast	5 ms	1	⩾120/sec
Fast	25 ms	4	40-60/sec
Fast	50 ms	8	20/sec
Fast	100 ms	16	10/sec
Slow	200 ms	16	5/sec
Slow	500 ms	64	2/sec
Slow	1000 ms	128	⩽1/sec

3-96. Buffer Circuit

3-97. The input to the buffer circuit is a unity gain amplifier (U210 and associated components) which establishes the signal VBOOTSTRAP equal to the input signal. This bootstrap voltage is used in the biasing circuits for the FET switches and in the driving circuit. The automatic zero circuit of FET switches Q231 and Q233 is turned on when a measurement is not being taken. When the switches are turned on, the voltage at the junction of Q231/C230 equals the input (Vin) plus the offset of U210. The voltage at the junction Q233/C230 equals Vin, plus the offset of U210, plus the offset of U211. As a result, the negative of the offset of U211 is stored on C230, and when a measurement cycle takes place and FET switch Q232 is turned on, the stored voltage cancels the offset of U211. The net offset voltage is zero.

3-98. The driving circuit changes the signal from a –15V and –20V logic system into a +2V and –0.5V system for the D-MOS FETS. The signal then passes through the non-inverting output amplifier (U211) with its gain determined by the state of the FET switches in its output. The gain will be either unity with Q236 on for the 10V and 1000V ranges, eight with Q237 on for the 1V and 100V ranges, or sixty four with Q238 on for the 100 mV range. The end result is dc voltage output to the A/D Analog section that is between zero and ±16.5 volts and proportional to the input.

3-99. OHMS CONVERTER (8522A-1033)

3-100. The ohms converter produces a current in the unknown resistance (RX) being measured so that the voltage drop is proportional to the value of RX. The method used varies with the magnitude of the resistance.

3-101. If RX is ≤19.9999 kilohom, it is placed in the feedback loop of an op amp as shown in Figure 3-15. In this configuration, the voltage at the high input terminal should be at or near zero with an infinite input impedance. As a result, all of the current delivered by the reference current (IREF) flows through RX which can be computed from the output voltage (V0) with the formula $R_X = V_0 / I_{REF}$.

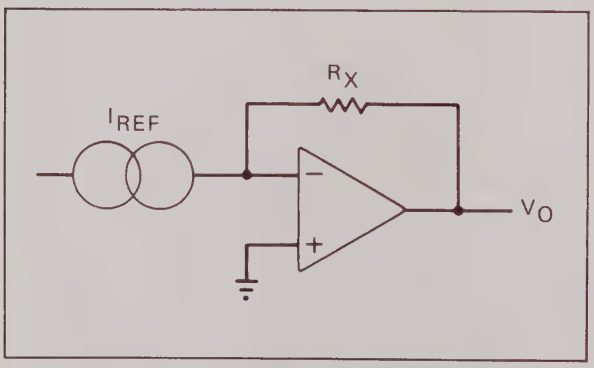


Figure 3-15. Low Ohms Measurements

3-102. With resistances >20.000 kilohm, a voltage reference (VREF) is used in lieu of the IREF as shown in Figure 3-16. With a known reference resistor, the value of RX can be computed from the formula $R_X = R_{REF} (V_0 / V_{REF} - V_0)$.

3-103. The output of the ohms amplifier is connected through the I/O Switching section to the DC Buffer and digitized in the A/D Converter. The gain of the DC Buffer varies with the range selected and is 64 for 10Ω, 1 for 10 MΩ, and 100 nS; and 8 for the remaining ranges. Once amplified and digitized RX is computed using the formulas above.

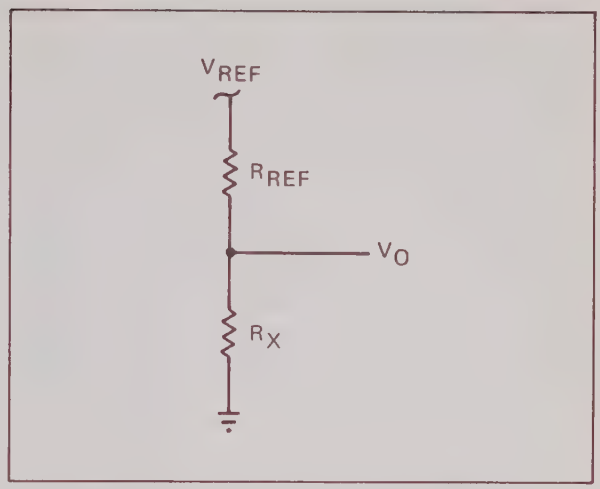


Figure 3-16. High Ohms Measurements

3-104. Measurements of less than 20 kilohms are made using a precision current reference. Measurements of 20 kilohms, or greater, and conductance are made using a voltage reference. Each method is described in detail in the following paragraphs.

3-105. Low Ohms

3-106. An accurate reference voltage of –6.5V is input to U302 of the current source from the Analog A/D circuit. The 3.077 gain of the inverting op amp places +20V at TP304 and on one side of the precision resistor network (R310, R313, R316). When the low ohms function is selected, that portion of the network applicable to the range selected is held at virtual ground so that $I_{REF} = 20V / R_{REF}$. The value of IREF varies from 0.1 mA for the 10 kΩ range to 1.0 mA for the 1000Ω range with K301 energized, to 10 mA for the 100 and 10Ω ranges with K302 energized. On the three lowest ranges, the relay contact resistance, when taken with the lead resistance, could have a significant effect on IREF. This error is counteracted by the feedback paths through Q305 for the 10 and 100Ω ranges and through Q302 for the 1000Ω ranges. This constitutes a Howland Current Source which theoretically offers infinite output resistance.

3-107. High Ohms

3-108. Resistances >20 kilohm and conductance measurements are made using a reference resistance and VREF of 6.5 volts. The voltage reference is sampled, and the reading stored by the I/O Switching section. This ensures that long term variations are removed whenever a high ohms range is selected. The reference resistance is 450 kΩ (R321 and R315) with K303 energized for the 100 kΩ range. For the 1M, 10M, and 100 nS ranges, K303 is de-energized to add R319 and R320 to the circuit and provide a reference of 4.5 MΩ. Relay K304 is energized for all high ohms ranges.

3-109. Input Ohms Amplifier

3-110. The input ohms amplifier has a bi-polar differential input stage (Q309), an op amp (U303) and a large current sink capability with high voltage protection in the transistor arry U301. The output is also protected by the posistive temperature coefficient thermistor R101 and the zenor diode CR105 in the I/O Switching section.

3-111. The input stage is protected by current limiting resistor R332, plus Q310 and Q311. If the input terminals are left open in low ohms, Q317, and the divider R113 (I/O Switching section), and R343 clamp the output voltage to less than 8 volts. It also opens the feedback path to the ohms amplifier. For a standby function, a feedback path is provided through a turned on Q308.

3-112. AC CONVERTER (8522A-1034)

3-113. The 8522A AC Converter is a true RMS Converter. It mathematically obtains the conversion by ranging the input to 1 volt full-scale signal, averaging the square value of the signal, and then taking the square root of the averaged squared signal.

3-114. The converter accepts signals from the input terminals and converts the signal to a dc level proportionate to the RMS value of the input. The dc output signal will be between zero volts and plus sixteen volts (full scale reading). The signal is routed through five stages, which are: the ranging amplifier, balance amplifier, squaring amplifier, square root amplifier, and integator/filter.

3-115. The range and balance amplifiers operate independently, but the remaining three work in conjunction with each other. The range amp brings the input signal within the 1V rms range. The balance amp converts the signal to a dc absolute value. The conversion to rms is performed by the squaring amp, integrator, and square root amp, using a double logarthmic response, i.e., $2 \log X = \log X^2$.

3-116. Range Amplifier

3-117. The range amplifier is an inverting amplifier with four user selectable ranges. They are, at full scale, 2, 16, 128, and 1024 volts (limited to 650V rms or 1000V peak for safety). The three higher ranges are multiples of eight (23) for simpler microprocessor implementation in ranging. A full scale output of the range amp is 1 volt.

3-118. Either AC or AC plus DC can be accepted in the range amp. C401 normally blocks dc. However, if the AC + DC funciton is selected, K401 is energized to bypass the capacitor. FET switches Q401 through Q409, and Q421 are turned on by the Analog Controller in the sequence shown in the chart on the schematic diagram.

3-119. Using the 100V range as an example, the schematic chart shows that FETs Q403, Q404, and Q421 are enabled, and the remaining Range Amplifier FETs are disabled. Q403 and Q404 are enabled to route the input signal through the 100V attenuation circuit prior to application to U401. Q421 is enabled to ground out any stray capacitance from the 10V range.

3-120. Amplifier U401 uses both feedback and summing mode shunt capacitance to provide for stable operation as an adjustment of high frequency gain. The stray capacitance of the FET switches also provides stability to the amplifier on the 1 volt range. Failure of one of the stabilizing capacitors could result in oscillation within that range.

3-121. All dc adjustments of the Range Amplifier are normalized to the 1 volt range adjustment (R487). The frequency adjustments and capacitive adjustments are normalized to the 1000 volts range adjustment (R438).

3-122. Balance Amplifier

3-123. The balance amp is a precision halfwave rectifier in an inverting unity-gain configuration. It consists of U402 for the gain, and the dual transistor transconductance drivers Q410 and Q411 for fast switching of the rectifier diodes. The current is forced through the hot carrier diodes CR405 or CR406 and through either R454 or R456, as determined by the polartiy of the signal. The output of the balance amplifier can be viewed at TP403.

3-124. Squaring Amplifier

3-125. Outputs of the range amp and balance amp are summed at the input of the squaring amp (U403). The op amp output (J419) represents twice the natural logarithm of the summed current input. The squaring is accomplished using the forword biased PN junctions of a transistor (Q414A, Q415B) and the inverse result from Q415A, as controlled by the output of the Square Root amplifier. Q414 and Q415 are dual transistors designed to provide logarithmic conformity and good frequency characteristics. They are placed in the circuit so their offsets cancel, allowing a tighter gain adjustment with R481. High frequency stabilization between 300 kHz and 1 MHz is provided by R468 and C455.

3-126. Integrator/Filter

3-127. The integrator is a transfer impedance amplifier (U404) which produces a voltage at its output (J420) for a current input. The output of the squaring amp is acted on by the Integrator/Filter and Square Root amplifier to produce a dc voltage that is the RMS value of the signal at the input. The circuit has two selectable filters of 100/200 ms (fast) and 500/1000 ms (slow). The filters are switched on and off with the FET switches, Q416 through Q419. The slow filter is switched in with Q416 and Q417, and the fast filter is switched in with Q418 and Q419. The filter is a three-pole filter with the FET switches shifting the poles lower in frequency (slow) or higher (fast).

3-128. Square Root Amplifier

3-129. The square root amp (U405) operates in conjuction with the integrator in performing the square root function. The squaring amp provides the current drive for Q415A, which is the current source for the integrator. The square root amp is in the feedback loop of the integrator. Any signal at the output of the integrator effects both the square root amplifier and the integrator. The output voltage of the square root amp (TP404) is the natural logarithm of the current through R483.

3-130. Stability for the overall loop is provided by C446. Diode CR408 and R482 prevent the circuit, i.e., square root amp and integrator, from latching.

3-131. Feedforward Temperature Compensation (FTC) Circuit

3-132. The FTC circuit (U408) is not in the signal path for the ac measurement. It is used to correct for dc drift in the balance (U402) and squaring (U403) amplifiers. The result is the excellent high frequency performance of the ac converter while maintaining dc performance.

3-133. A/D CONVERTER (8522A-1035)

3-134. The A/D Converter uses Fluke's patented Recirculating Remainder (R2) method of converting a dc input signal into a binary, byte-serial, data stream. Operation of the A/D Converter is controlled by the microprocessor in the Analog Controller. The converter consists of five sections, which are: the reference circuit, the polarity detector, the automatic zero, the current ladder, and the X and Y remainders. A sample is generated when five passes through the ladder network have been executed, resulting in 21 bits of binary data. It requires 1.77 ms to complete the five passes (one sample) in the high speed mode.

3-135. The Reference circuit (U501, U502, U503, and associated components) provides a 6.5 volt reference to the current ladder. The reference varies in polarity as the inverse of the input. In some units U501 is replaced with a Ref Amp PCB Assembly (schematic 8520A-1045 or 8520A-1046) that plugs into the Analog Assembly in place of U501. Operation of the ref amp circuit is identical to the discrete component U501, and either may be used as a replacement.

3-136. The first step in the sample process is the autozero. The Analog Controller command makes "AZ" active on the gates of FET switches Q528 and Q529 to zero the circuit in preparation for a new input. When auto zero is complete, the Controller makes "G" and then "I" active to close FET switches Q529 and Q512, repectively. This allows the input to enter U506, which acts as a polarity detector.

3-137. The Reference circuit is assigned the opposite polarity from the input, based on a polarity decision made by the Analog Controller. The correct polartiy reference voltage is applied to the current ladder. Each branch of the current ladder has twice the resistance of the succeeding branch, corresponding to the binary digits 8, 4, 2, 1, and 0.5. The microprocessor closes the FET switches in the ladder, one at a time, starting with Q521 as a pass is made through the ladder. If there is excess current from the ladder, it will flow in CR505. The FET switch remains closed, and the excess current is tried on the next switch in succession. If there is no excess current, or there is a current debt, current flows through CR506 and causes a polarity change in the ladder. The polarity change causes the Controller to re-open the FET switch and try the next switch in seccession. The same process is repeated on the four remaining FET switches to complete the first pass. In most cases there is current remaining after the pass. Switch Q529 opens when the pass is complete and switch Q526 is closed by the controller to store the remainder in the "X" channel.

3-138. The remainder current flows in the loop around U505 where there is a voltage gain of 10, and is stored in C506 when switches Q526 and Q531 are closed by the Analog Controller. Once the remainder is stored, the Controller opens Q512, Q526, and Q531 and closes Q529 and Q525. This returns the current to the ladder with a current gain of 16, in comparison to the original remainder, which is required to continue the 8, 4, 2, 1, 0.5 conversion. Thus, an "error" of 0.5 on the first pass becomes an input of "8" on the next pass.

3-139. The procedure for a pass through the ladder is then repeated, substituting the "Y" channel for the "X". When the pass through the ladder is completed, Q524 and Q530 are closed for the gain in U504, and C505 stores the remainder. Then Q512, Q524, and Q530 open and Q523 closes to retrieve the remainder for another pass. The retrieve "X" switch, Q525, remains closed until Q524 and Q530 close to store the "Y" remainder.

3-140. The process alternates between the "X" and "Y" channels until the five passes through the ladder are complete. Each pass overlaps by one bit, to allow for correction of the bit switch closures that are in error. The analog controller then correlates the data into a three byte word, sends the sample for display, and prepares the circuit for the next sample.

3-141. An example using a DC Buffer output of –10.2 volts follows. The circuit is autozeroed, Q529 closes, then Q512 closes, and the reference voltage is set at +6.5 volts. Q521 turns on, and remains on. When the Controller closes Q519, a polartiy change occurs, and the switch must be reopened. When Q517 is closed, it remains on. Like Q519, Q515 and Q513 are reopened. Thus, the "8" and "2" bits are on. The first pass ends, and there is a remainder of –0.2 volts which is stored in the "X" channel as a voltage of +2.0 volts. It is retrieved with a net gain of

sixteen to appear equivalent to an input of –3.2 volts, and the process is repeated. This time only Q517 and Q515 remain closed, and there is again a remainder of -0.2 to be stored in the "Y" channel. The process is repeated three more times. However, the passes will be identical to the second, other than alternating storage channels.

3-142. To review the process, it begins with an autozero followed by setting the reference voltage. The next step is the first pass through the ladder. The remainder is amplified and stored and then sent through the ladder. This is repeated for five passes and then the sample is sent to be displayed, and the cycle begins again for another sample.

3-143. ANALOG CONTROLLER (8522A-1036)

3-144. Range and function information from the Digital Controller is accepted by the Analog Controller, interpreted, and output to circuits on the Analog PCB. Some signals for the measuring circuits originate with the microcomputer in the Analog Controller. Each of the circuits within the Analog Controller are detailed below.

3-145. Guard Crossing Circuit

3-146. Data from the Digital Controller enters the circuit in serial form at pulse transformer U627. The resultant output fires the "single shot" U609 for a serial input to the UART U602. The data is processed, and output, as parallel data, to the controller bus.

3-147. Data originating in the Analog Controller is transmitted on the bus, in parallel to U603. Then it is translated to bit-serial format and output through U610 and U627 to the crossing and the Digital Controller.

3-148. Microcomputer

3-149. The microcomputer is a mask programmed one-chip microprocessor, complete with its integral RAM and ROM. Under the control of the program, as modified by interrupts from the digital controller, the microcomputor outputs data to the I/O circuits and the data bus.

3-150. Switch S601 is not installed in the circuit. An 8-pin dip socket is available to insert a four-pole dip switch, if desired, for use during troubleshooting. Jumpers may also be used to short across the socket pins when required. Switch 1 would be the two pins toward the front of the instrument if this method is used.

3-151. I/O Circuits

3-152. Data on the bus is latched in U603 and decoded in U604 to provide control signals to the UART U602 or a strobe to one of the following latches or buffers: U607-9, U608-4, U611-1, 15, U612-1, U617-9, U618-11, U619-11, U620-11, and U621-11. Data from the bus is latched into or strobed through the applicable latch or buffer to transmit a command to another circuit or place data on the bus for the microcomputor.

3-153. Interrupt Circuit

3-154. Data on the bus (DB0-DB5) is latched into U607 on the decoded signal from the I/O circuit. A signal at U607-12 and U607-15 are ANDed with TBE and DAV, from the UART, respectively to generate an interrupt at wired OR U615 and at U601-6. The remaining signals at U607 provide enabling signals to monitor the UART S1 and EPE signals, the microcomputor T0 signal, and the trigger circuit.

3-155. Trigger Circuit

3-156. Guard crossing transformer U627 (pins 6, 8, 9, and 11) is bidirectional and receives trigger strobes from the Digital Controller. The interrupt circuit controls the output of the tigger at U608-9 to insure that a trigger interrupt does not interfere with a reading in progress. U608-13 is held low from U607-10 in the interrupt circuit to disable the latch when a reading is in progress. When the reading is complete, U607-10 goes high, enabling the latch to await the next trigger.

3-157. Reset Circuit

3-158. A reset signal is sent to the microcomputer from the Reset Circuit any time that power is applied or lost. Line voltage triggers the retriggerable one shot U609. The one-shot output, in conjunction with a low output at U605-4, enables the counter U605 and allow the line voltage to pulse the counter. When the count sets U605-4 high, the counter is disabled and stays that way until the one-shot U609 is not triggered. Removal of the constantly recurring pulses reset the counter, and the low going output resets U607 and gives a RESET signal to the microcomputer.

Section 4
Instrument Assembly/Disassembly

4-1. INTRODUCTION

4-2. Each of the following procedures deals with the removal/replacement of a single item or feature from the instrument. They are listed in a disassembly sequence, however, all previous steps may not be required to obtain access to the desired part/assembly of the instrument. Reassembly can be accomplished by performing the steps of the applicable procedure in a logically reversed sequence.

4-3. TOP/BOTTOM COVER

4-4. Removal and replacement of both the top and bottom covers is accomplished in the same manner once the desired cover has been placed toward the operator for ready access.

1. Remove the three screws across the front edge of the cover.

2. Remove the three screws across the rear edge of the cover.

3. Lift the cover straight up, guiding it out of the grooves in the front and rear panels.

4-5. TOP ANALOG GUARD COVERS

4-6. The analog section has a top guard cover with access ports for the calibration adjustments. The top cover must be removed to gain access to the instrument compartment prior to beginning the procedure as follows:

1. Remove the screws securing the top guard cover to the internal guard chassis.

2. Remove the side screws, one centered on each side, through the access ports.

3. Lift the rear end of the top guard straight up, then remove it from the instrument compartment by moving it toward the rear to clear the lip on the front of the compartment.

4-7. INTERNAL GUARD COVERS

4-8. The analog assembly has two internal guard covers. One is located over a portion of the AC Converter, and the other over part of the DC Buffer. In both cases, the top cover and the top analog guard cover must be removed to gain access to the internal guards. Separate procedures are given for removing each of the guard covers.

4-9. DC Buffer Guard

1. Press upward on the side of guard at the front right corner until it releases from the studs.

2. Lift the guard up and toward the center of the instrument to clear the wiring harness along the side of the guard.

4-10. AC Converter Guard

1. Press upward on the side of the guard at the front left corner until it releases from the studs.

2. Lift the guard up and away from the enclosed components.

4-11. FRONT PANEL DISPLAY ASSEMBLY

4-12. The Front Panel must be removed to gain access to the Display Assembly and its components. To reach screws required for removal, the top cover must be removed. Removal of the top analog guard cover is not required but removal does improve access to the screw heads.

1. Remove the two screws located on the rear upper corners, attaching the front panel to the frame.

2. Using both hands, squeeze the top and bottom of the panel together to clear the tabs holding the panel in place.

3. Once the panel is clear of the tabs, move the panel forward to clear the tabs.

4. Remove the wires connecting the front panel input connectors to the Analog Assembly using a pair of needle-nose pliers.

NOTE

To facilitate the replacing of wires on terminals during assembly, the color code is molded into the panel next to each terminal.

5. Disconnect the ribbon cable connecting the Display Assembly to J11 on the Digital Assembly.

6. Remove the four screws securing the Display Assembly to the frame and lift the assembly clear of the instrument.

4-13. ANALOG ASSEMBLY

4-14. Remove the Analog Assembly from the instrument compartment using the following procedure. Prior to starting, the top cover, the top analog guard cover, and either the front panel or the five wires to the front panel input terminals must be removed.

1. Disconnect the ribbon cable connecting the Analog Assembly to the Digial Assembly.

2. Loosen the four retaining screws and remove the cover from the transformer and Transformer Assembly.

3. Disconnect the cable connecting the transformer to the Analog Assembly and take it back through the slot in the transformer compartment.

4. Remove the two screws attaching the rear input connector to the rear panel, then push the connector through the rear panel into the instrument compartment.

5. Remove the 11 screws securing the assembly to the instrument frame. Six of the screws are through the PCB to the bottom guard, and the other five fasten the hardware attached to the rear of the assembly to the rear panel.

6. Lift the rear of the assembly and move it out toward the rear of the instrument, exercising caution to prevent damage to the GUARD and REAR INPUT switches that are attached to the front of the assembly.

4-15. TRANSFORMER AND TRANSFORMER ASSEMLBY

4-16. Remove the transformer and Transformer Assembly from the instrument compartment using the following procedure. Prior to starting, the top cover and the top analog guard cover must be removed from the instrument.

1. Loosen the four retaining screws and remove the cover from the transformer.

2. Disconnect the cable connecting the transformer and Analog Assembly from the Analog Assembly and bring the cable back through the center divider into the transformer compartment.

3. Remove the cable clamp from the transformer compartment frame.

4. Remove the eight screws attaching the transformer compartment to the frame. Four are used on the outside frame and four on the center frame.

5. Lift the transformer compartment containing the transformer and Transformer Assembly straight up and out of the instrument compartment.

4-17. DIGITAL ASSEMBLY

4-18. Remove the Digital Assembly from the instrument compartment using the following procedure. Prior to starting, the top cover, the transformer, and the Transformer Assembly must be removed from the instrument.

1. Disconnect one end of the guard crossing ribbon cable connecting the Analog and Digital Assemblies, and bring the cable through the slot in the center guard and frame.

2. Remove the three screws holding C201 to the outside frame.

3. Remove the four hex-head bolts and nuts securing the remote connectors to the rear panel.

4. Disconnect the earth ground wire from the lug on the assembly (P30).

5. Disconnect the three BNC wires from the two lugs on the main part of the Digital Assembly (P32, P33) and from the lug on the vertical pcb (P32).

6. Disconnect the ribbon cable connecting the Display Assembly to J11 on the Digital Assembly.

7. Turn the instrument over, and remove the bottom cover from the instrument if not previously done.

8. Remove the five screws securing the Digital Assembly PCB to the tabs in the instrument compartment.

9. Lift up the front of the assembly and slide the PCB forward and out of the instrument compartment.

4-19. BOTTOM ANALOG SHIELD

4-20. Once all other assemblies have been removed from the instrument compartment, the bottom portion of the analog guard can be removed by taking out the three screws from the outside frame and the three from the center frame. Since this item is hardware with no active components, removal is seldom necessary.

Section 5
Troubleshooting

5-1. INTRODUCTION

5-2. Troubleshooting for the 8522A is contained in Tables 5-1 through 5-13, Figures 5-1 through 5-9, and in the following paragraphs. These tables are tabular flow charts that direct you to another step, as determined by the response to a decision step. If no decision is required perform the next step of the table in sequence.

5-3. The troubleshooting tables are built around the self tests incorporated into the software. However, the tables assume there is some response when the POWER switch is depressed by the Operator. If there is no response from the instrument use the Power On Procedure below before proceeding. If there is a response it may be an Error Code (the display shows "Err XX" with the "XX" representing a two character display). A list of these Error Codes and a brief explanation of each is given in Table 5-4. The tables cover procedures for troubleshooting the Front Panel, the Digital PCB, and the Analog PCB. Until you accumulate sufficient experience you should progress through the tables in sequence. You will either skip rapidly through the table or be referred to another table if the problem is not with the circuit covered.

5-4. POWER ON PROCEDURE

5-5. If the instrument does not respond to the power on command check the power supply test points (TP7XX on the analog pcb and TP201 on the Digital PCB) for the correct voltages as shown on Table 5-5, Typical Voltages and Waveforms. If all voltages are correct, continue with the Front Panel Troubleshooting, Table 5-1.

5-6. If all of the voltage tests are out of tolerance or absent, check the transformer primary inputs, i.e. the line cord, the fuse, the thermal fuse, the voltage selector switches and their settings, the line voltage outlet, the POWER switch, and the connectors to the Transformer PCB. If all of these are good check the transformer itself.

5-7. If part of the voltage tests are within tolerance check the secondaries and/or rectifier circuits for the failed tests. The Digital PCB Power Supply has an adjustment and J201 can be removed to prevent any loading from the digital circuits. There are no adjustments on the Analog PCB Power Supply; however most of the circuits have jumper plugs that can be removed to insure the test does not fail due to loading by the circuits. Remove J19 from the Analog PCB to disable the DC Buffer and I/O Switching circuits, J20 for the Ohms Converter, J21 for the AC Converter, and J22 for the Analog Controller.

5-8. SPECIAL PROCEDURES

5-9. Special procedures are provided for testing the Analog Controller and A/D Converter circuits. The procedures are called out in the Analog PCB Troubleshooting tables when required.

5-10. ANALOG CONTROLLER TESTS

5-11. Three test programs are available in the Analog controller microprocessor to test the digital functions of the Analog PCB. These tests may be an aid in troubleshooting the Analog Controller if the instrument consistently displays an error message, fails all steps of Math Program #1 Test #1 (the power supply outputs should be checked first), or consistently reads gross errors during measurements. Prior to beginning the microprocessor tests, the presence of the signals described in the first sub-paragraph below should be verified. An 8-pin dip switch must be installed in the empty S601 socket, next to the analog controller microprocessor, before any of the tests can be selected. In addition, the instrument input terminals must be "open" and the guard crossing cable disconnected. These conditions cause a front panel error display, which should be ignored during these tests. When the instrument operates as a voltmeter, the microprocessor does not check the status of S601; however, if TP607 is shorted to TP608, it resets the analog

controller microprocessor and the switch status is "read". When the tests are completed, return the instrument to voltmeter operation by setting all of the switches on S601 to OFF, reconnecting the guard crossing cable, and shorting TP607 to TP608, which forces the microprocessor to check the status of S601. The selection method and operation of each of these tests are described below.

5-12. Analog Controller Input Signals

5-13. Verify the presence of the following signals before testing the Analog Controller microprocessor:

1. Readings of -15V dc at TP603 and -20V dc at TP604 for a +5V dc logic signal.

2. A line frequency square wave at U614-4.

3. A 2 MHz square wave clock at TP605.

4. A pulse (ALE) approximately every 12.5 msec at TP602 (variable with the input line frequency).

5. A logic high reading (INT) at TP606.

6. A logic high that goes low at TP601 (RESET) when TP607 is shorted to TP608, and returns high approximately 400 ms (60 ms for a 400 Hz line frequency) after the short is removed.

5-14. Latch Test

5-15. This test applies a continuous circulating signal to a component selected by the S601 test switch. The microprocessor checks the status of S601 constantly during the Latch Test to determine which component receives the signal. The output of the selected component can be monitored with an oscilloscope or logic probe. Use the following procedure to perform the latch test:

1. Insure S601 is installed and the guard crossing cable is disconnected.

2. Set switch #1 of S601 to ON and the remaining switches to OFF.

3. Short TP607 to TP608 to reset the Analog Controller.

4. Select the component to be exercised by setting S601 to the position indicated in Table 5-10.

5. Observe the output pins of the selected component for a recurring pulse.

NOTE

An oscilloscope setting of 5 volt/div and 50 µs/div should give a display of the recurring pulse.

6. Set the switches on S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and make it "read" the switch setting.

5-16. UART Test

5-17. The UART test checks the response from the transmitted data. Before each test a byte of data is written into Port 1 (U601-27 through 34). An incorrect response stops the test and the failed step can be determined by reading the data byte in Port 1. If the test fails, all of the data bits in the port are at a constant state. If the test passes the test is continuously repeated and the three low order bits are changing states constantly. Use the following procedure to perform the UART test:

1. Insure S601 is installed and the guard crossing cable is disconnected.

2. Set switch #2 on S601 to ON and the remaining switches to OFF.

3. Short TP607 to TP608 to reset the Analog Controller.

4. Monitor the status of Port 1 for a constant level, i.e. either always high or always low, on all eight bits of the port.

5. If the three low order bits (U601-29,28,27) are constantly changing states the instrument passes the test. If all eight bits are at a constant level the controller is locked on the failed test and the missing signal can be identified by decoding the three bits using Table 5-11. Once the missing signal has been identified refer to the UART and Interrrupt Troubleshooting Procedures paragraph that follows the Interrupt Test.

6. Set the switches S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and force it to "read" the switch setting.

5-18. Interrupt Test

5-19. The Analog Controller microprocessor generates a DAV and an external trigger interrupt for use within the instrument. They are tested in a series of six steps, with a byte of data written into Port 1 (U601-27 through 34) at the beginning of each step. If the step fails the byte is locked into Port 1 and it can be decoded to determine the failed step. If the test passes it is continuously repeated and the four low order bits are constantly changing states. Use the following procedure to perform the interrupt test:

1. Insure S601 is installed and the guard crossing cable is disconnected.

2. Set switch #4 of S601 to ON and the remaining switches to OFF.

3. Short TP607 to TP608 to reset the Analog Controller.

4. Monitor the status of Port 1 for a constant level, i.e. either always high or always low, on all eight bits of the port.

5. If the four low order bits (U601-30,29,28,27) are all changing level the instrument passes the test. If all eight bits are at a constant level the controller is locked on the failed test and the missing signal can be identified by decoding the four bits using Table 5-12. Once the missing signal has been identified refer to the UART and Interrupt Troubleshooting Procedures paragraph that follows this test.

6. Set the switches on S601 for either the next test or all OFF (to resume voltmeter operations), then short TP607 to TP608 to reset the Analog Controller and force it to "read" the switch setting.

5-20. UART and Interrupt Troubleshooting Procedures

5-21. Once the missing signal has been identified the tests in Table 5-13 can be used to locate the defective compontent(s). The table lists only the pertinent IC's; however, associated components should be checked at the same time. Check for missing components, improper values, defective components, shorted inputs or outputs, bent legs that could produce capacitive coupling (CMOS) or thermal problems, shorted bus lines, or lines shorted to logic common or logic ground. Repair or replace the defective component(s) when located then repeat the test during which the fault was found.

5-22. A/D CONVERTER TEST

5-23. The A/D Converter test permits the examination of the A/D ladder during a conversion. A known voltage is applied to the terminals and the output monitored for a waveform that can be translated to a digital number corresponding to the most significant digit of the input. Use the following procedure to perform the A/D Converter test:

1. Prepare the instrument for normal operation. Select Volts DC and fix the range at 10 Volts.

2. Apply a known input >0 and <0.2 volts from a variable source to the input terminals.

3. Using a dual trace oscilloscope connect one trace to TP509 for sync and observe the waveform at TP508 with the other.

4. The waveform at TP508 can be decoded to the digital value of the most significant digit. It represents values of 8, 4, 2, 1, and 0.5. In this case all should be high, as shown for 0 volts in Figure 5-8.

5. Vary the source to a known input >1.0 and <1.2 volts.

NOTE

The input must be read by the 8522A as >1 to insure data in the one bit but <1.5 (approximately) to keep data from the 0.5 bit. An input of 1.1 volts insures the correct digital value.

6. The waveform at TP508 changes to that shown in Figure 5-8 for 1 volt.

7. Rotate the source through the remaining voltages in Figure 5-8. Insure the input is greater than the basic so the tolerance of the instrument does not put the input below the basic value.

8. Verify the waveform representing the digital count at TP508 is correct for each input voltage.

9. If the waveform is incorrect for any input check that portion of the ladder.

Table 5-1. Front Panel PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
	NOTE *All tests are made in relation to ⏚ at TP6 unless otherwise noted.*		
1	Disconnect the instrument from any external controller.		
2	Depress the POWER switch to apply power to the instrument.		
3	Does any portion of the Display or any indicator illuminate?	17	4
4	Is VUNREG present at TP7 (≈8V)?	5	15
5	Are there recurring strobe pulses at U7-11?	7	6
6	Check U7 and its inputs from the digital PCB. Replace or repair as required then resume at step 3.		
7	Is there approximately 4.1V present at TP4. (VUNREG less the 3.9V drop of Zener CR1.)	9	8
8	Check Zener diode CR1 and R2. Repair as required then resume at Step 3.		
9	Is U1-1 High?	10	15
10	Does U1-11 toggle?	11	15
11	Is Vcc1 present at TP5 (≈5Vdc)?	12	15
12	Does at least one input data line (D0-D7) toggle?	13	15
13	Do all the outputs of U1 toggle?	16	14
14	Check U1 and RN1. Repair or replace as required then resume at step 3.		
15	Check the connector, cable, and output from the Digital PCB. Repair as required the resume at step 3.		
16	If all the above checks are good, but none of the display segments are illuminated it indicates a massive failure, i.e. two or more components. Check combinations that would effect both the 7-segment and 14-segment displays, e.g. U2 and U3, etc. Repair as required then resume at step 3.		
17	Is the REMOTE indicator illuminated?	18	19
18	Check for an invalid $\overline{\text{REMOTE}}$ input from the Digital PCB. Repair as required then resume at step 17.		
19	Select Math Program #1 (TEST), Test #3 (Key & LED Tests). Push RESET one time to select the first step of the LED test, i.e. all Segments and indicators illuminated.		
20	Does the display have the same segment blank in all 7-segment displays?	21	26
21	Do all outputs of U9 toggle?	23	22
22	Check U9 and its inputs from the digital PCB. Repair as required then resume at step 19.		
23	Do all inputs to U10/U11 toggle?	25	24
24	Check U21, CR2 and RN3. Repair as required then resume at step 19.		
25	Check for a constant low output from U10/U11. Repair as required then resume at step 19.		
26	Does the display have the same segment blank in all four sections of the two dual 14-segment displays?	27	32
27	Do all outputs of U12 toggle?	29	28
28	Check U12 and its inputs from the digital PCB. Repair as required then resume at step 19.		
29	Do all inputs to U23/U24 toggle?	31	30
30	Check U22 and RN6. Repair as required then resume at step 26.		
31	Check for a constant low output from U23/U24. Repair as required then resume at step 19.		

Table 5-1. Front Panel PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
32	Is one 7-segment display digit and/or one half of a 14-segment display blank?	33	34
33	Check that the output from U2/U3 and U1 that drives that segment or segments toggles. Repair as required then resume at step 19.		
34	Is one segment in one display blank?	35	36
35	Replace the affected LED. If the problem is not corrected check the land pattern leading to the affected LED. Repair as required then resume at step 19.		
36	Depress RESET one time to advance the display.		
37	Do any segment(s) still glow, except the decimal point of the first digit?	38	39
38	Check U5. Repair as required then resume at step 19.		
39	Depress and release the RESET key switch for each step to sequence through every segment of the 7-segment and 14-segment display.		
40	Does more than one segment of the display illuminate during any single step of the sequence?	41	42
41	Check the transistor arrays U10, U11, U23, and U24. Repair as required then resume at step 39.		
42	Depress any Keyswitch except SHIFT to go to the Key portion of Program #1, Test #3.		
43	Sequence through the keys checking for the indication shown in Table 5-6.		
44	Are all indications correct?	50	45
45	Does at least one indicator illuminate?	47	46
46	Check U6-1/15 for a strobe, check the outputs of U5 for a toggling signal, and check the inputs to U6 with the applicable switch depressed for a pulse. Repair or replace as required then resume at step 42.		
47	Are the indicators correct for the keyswitches that have a display?	48	49
48	Check for a row signal on the switches affected from U5. Repair as required then resume at step 42.		
49	Check U6 for incorrect test indications. Repair as required then resume at step 42.		
50	The Front Panel troubleshooting is complete.		

Table 5-2. Digital PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE YES	NO
1	This test of the Digital PCB assumes that the instrument either does not operate correctly, or if the readings are incorrect an attempted Calibration Procedure was unsucessful. *NOTE* *All measurements made during the procedure are in reference to TP2 (TP10 alternate), unless stated otherwise.*		
2	Is the Front Panel Display illuminated?	24	3
3	Is +5V dc present at TP1 (Vcc)?	7	4
4	Is Vunreg (approx 8V) present at J12-3,6 (or Front Panel TP7)?	5	6
5	Check U202 and its associated circuitry. Repair as required then resume at step 2.		
6	Check the rectifier CR1/CR2, the filter on the Transformer PCB A4, and the transformer T201. Repair as required then resume at step 2.		
7	Is there a high logic level at TP3 ($\overline{\text{RESET}}$)?	9	8
8	Check the RESET circuit U22, U28, U36, U23, and their associated components. Repair as required then resume at step 2.		
9	Is there a 4 MHz clock at TP7?	11	10
10	Check Y1 (8 MHz crystal), U19, U20, and their associated components. Repair as required then resume at step 2.		
11	Remove J14.		
12	Does the front panel display illuminate now?	42	13
13	Reinsert J14. *NOTE* *An active signal, as used in the remainder of these tests, means a constantly changing logic level, changing levels at a rate that makes it difficult to interpret the data.*		
14	Is there an active signal present at TP6 ($\overline{\text{INT}}$)?	16	15
15	Check U17 and its enabling Interrupt inputs. These include the Phase Lock Loop circuit through U35, DR from the UART through U33-2, and REM INT from the remote circuit through J14-9. Repair as required then resume at step 2.		
16	Check the following microprocessor signal points for an active signal: TP5 $\overline{\text{M1}}$ (Output) TP8 $\overline{\text{WAIT}}$ (Input) U18-20 $\overline{\text{IOREQ}}$ (Output) U18-19 $\overline{\text{MEMREQ}}$ (Output) U18-28 $\overline{\text{RFSH}}$ (Output) U18-21 $\overline{\text{RD}}$ (Output) U22 $\overline{\text{WR}}$ (Output)		
17	Are all points active?	19	18
18	If any of the remaining signals are incorrect check the microprocessor U18 (substitution is normally the best method of checking the microprocessor). Repair as required then resume at step 2.		
19	Is there a high logic level at U18-17($\overline{\text{NMI}}$)? ($\overline{\text{NMI}}$ interrupts the Z80 CPU only on the following edges.)	21	20

Table 5-2. Digital PCB Troubleshooting (cont)

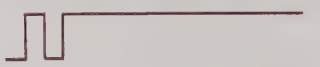
STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
20	Check U1 and its associated components. Repair as required then resume at step 2.	23	22
21	Is U19-8 ($\overline{\text{DISPLAY BLANK}}$) at a high level?		
22	Check U21, U19, U25, and their controlling inputs. Repair as required then resume at step 2.		
23	Refer to the Front Panel Troubleshooting Table. Repair as required then resume at step 2 of this procedure.		
24	Perform Math Program #1, Test #2.		
25	Does the Front Panel display PASS DGTL only?	36	26
26	Is Err 14 ROM displayed during the test?	27	28
27	Check the decoder U3. Repeat test #2 while checking the data and address lines of U10, U11, and U12 and U13 for an active state. Repair as required the resume at step 24.		
28	Is Err 15 RAM displayed during the test?	29	30
29	Check the decoder U2. Repeat test #2 while checking the data and address lines of U4 through U7 for an active state. Repair as required then resume at step 24.		
30	Is Err 17 HDWR displayed during the test?	31	24
31	Perform Math Program #1, Test #4. *NOTE* *This test program constantly sends a hex 40 (0100 0000) across the guard crossing from the digital microprocessor to the analog microprocessor, and back to the digital microprocessor. This is in addition to the sequential signal sent to the display.*		
32	Is the waveform reproduced below present at U26-20 (UART SI)? 	34	33
33	Is the waveform above present at U26-25 (UART SO)?	34	35
34	Check the UART U26, the address and data lines, and the microprocessor U18. Repair as required then resume at step 24.		
35	Proceed through the guard crossing circuit checking the waveform at each component. The waveform should be similiar to the one shown below, i.e. the data level a burst of ac; however, the base line level will vary between components due to inverting gates or circuits. Check the signal at U30-4, U37-5, and U38-14 on the digital PCB; U627-3, U602-20, U602-25, U614-12, U610-3, and U627-9 on the Analog PCB; and U38-6 and U36-4 on the digital PCB. If the signal goes into the analog UART but does not come out refer to the Analog PCB troubleshooting table. Repair as required then resume at step 24. 		
36	Does an attempted measurement reading result in an Err 3(X) UART or Err A(X) GARD display?	37	40
37	Check the phase lock loop for the proper signals for the actual input line voltages. Line Freq — U29-14 — U29-4 50 Hz — 50 Hz — 400 Hz 60 Hz — 60 Hz — 480 Hz 400 Hz — 57 Hz — 457 Hz		
38	Are the signals correct for the input line voltage?	40	39

Table 5-2. Digital PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
39	Check U29, U28, U32, U23, and their associated components. If the problem is not in the Phase Lock Loop check the UART circuit beginning at step 31. Repair as required then resume at step 36.		
40	Is the instrument used in a BCD or Parallel system?	41	76
	NOTE *The assumption is made at this time that the instrument can be controlled, and responds correctly, to local commands from the Front Panel. Accuracy of the instrument has not, as yet, been verified.*		
41	Does the instrument respond correctly to the remote controller?	76	42
42	Put the instrument in the BCD operating mode and remove any remote controller connections. Insert J14, if absent.		
43	Is AUTO LATCH (U101-8) active?	49	44
44	Is SEL (TP101) active?	46	45
45	Is J14 installed? Check remote acknowledge circuitry (U121, U104). Repair as required then resume at step 41.		
46	Is REM ADDR (U123-9) active?	48	47
47	Is J14 installed correctly? Check remote acknowledge circuitry (U123, U130, U104, U123, J14). Repair as required, then resume at step 41.		
48	Check U101, repair as required, then resume at step 41.		
49	Is SAMPLE SYNC period approximately equal to 1/(reading rate)? Period = from rising edge to rising edge.	53	50
50	Are DB0-DB7 active?	51	52
51	Check U103, U104, and U120. Repair as required, then resume at step 41.		
52	Check Data bus buffer and related components (U102, U103, U104, RN105). Repair as required, then resume at step 41.		
53	Is the instrument in a BCD system?	69	54
54	Is the instrument in a parallel 3-wire handshake system?	60	55
55	For 4-wire handshake system, setup s103 and push the RESET button on the front panel of the instrument.		
56	Is REQ B at a low logic level?	58	57
57	Check U121, U106. Repair as required, then resume at step 41.		

Table 5-2. Digital PCB Troubleshooting (cont)

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
58	Is REQ A high?	65	59
59	Check U104, U103, U106. Repair as required, then resume at step 41.		
60	Set up S103 for 3-wire handshake mode and push the RESET button on the front panel of the instrument.		
61	Is IN/OUT high?	63	62
62	Check STATUS 1 buffer (U107, RN102). Repair as required, then resume at step 41.		
63	Is PFLG high?	65	64
64	Check U110, RN102. Repair as required, then resume at step 41.		
65	Is PRESET (DATA TRANS) HIGH?	67	66
66	Check R106, R105, U104. Repair as required, then resume at step 41.		
67	Is PCTL (NEW DATA READY) high?	76	68
68	Check R107, R108, CR106, U108. Repair as required, then resume at step 41.		
69	Is AUTO CMD DEFEAT high?	71	70
70	Check U121, RN103. Repair as required, then resume at step 41.		
71	Apply a Low Logic level to some command input lines (function and range).		
72	Does the instrument respond properly? (correct function and range).	74	73
73	Check input latches and related parts (U109, U110, U124, U119, U121, RN101, RN102, RN103). Repair as required, then resume at Step 41.		
74	Is EXT CMD ENTRY high?	76	75
75	Check R107, R108, CR106, U108. Repair as required, then resume at step 41.		
76	Test of the Digital PCB is complete. If readings are incorrect check the Analog PCB using the Analog Troubleshooting Table.		

Table 5-2A. Digital PCB Troubleshooting with the Fluke 9000 Series

If a Fluke 9000 Series Micro-System Troubleshooter is available, the digital PCB may be tested using control of the Z80 CPU data bus, address bus, and control lines. Using a 9000 series mainframe and a Z80 Pod, three different modes of testing may be applied to the digital PCB: built-in tests, troubleshooting functions, and troubleshooting with the probe and a scaope.

The built-in test works mainly with what is called the kernal of the digital PCB (data and address bus, ROM, RAM, CPU control and status lines).Refer to the ADDRESS SPACE data in this table for the map of the address space and the ROM signatures. Replace U24 and/or U102 with a header on which pins are shorted in pairs (2-18, 3-17, 4-16, 5-15, 6-14, 7-13, 8-12, 9-11). In other words the buffered data bus is shorted to the ID0-ID7 bus by the D0-D7 and DB0-DB7 data bus lines may be tested with the 9000 Bus Test. The Z80 POD has more drive capability than the Z80 CPU.

NOTE

If an instrument works well with the 9000 Z80 POD but not with the Z80 CPU chip, try replacing the 8522A RAM.

The troubleshooting functions, are extremely helpful for debugging problems with the chips that are I/O mapped for the CPU. See the U25 Address Table for a map of the I/O address space. For example, use the READ @1008B function to see if the returned hex number matches the bit pattern that should be found on the input of U105 according to the positions of S103 and other external input signals.

By using the 9000 series probe in conjunction with the troubleshooting functions, bit patterns may be written to the remote output latches and the probe may be used to test for logic highs and lows. The probe may be synchronized with the address or data bus and then data may be read or written. The results of the probe should indicate whether the data that the Z80 POD is receiving matches the data that a RAM, ROM, or I/O device is sending, by probing directly at the devices pins.

	ADDRESS SPACE		
	ADDRESS	**SIGNATURE**	**COMMENTS**
ROM	0-1FFF	5F83	Standard 8522A, U10
	2000-3FFF	883F	Standard 8522A, U11
	4000-5FFF	C56C	Standard 8522A, U12
	7000-7FFF	1B7A	Standard 8522A, Remote Section, U13
	4000-5FFF	931E	-010 Option, U12
RAM	8000-83FF		Standard 8522A, U6, U7
	8000-87FF		-010 Option, U4, U5, U6, U7
I/O	0080-008F		Remote Interface
	00C0-00CF		Main Section

NOTE

9000 signatures apply only to 8522A software version 1.0

Table 5-2A. Digital PCB Troubleshooting with the Fluke 9000 Series (cont)

8522A = 4020 (U25) ADDRESS TABLE

The leading 1 in the addresses (e.g. 100xx) indicates an I/O signal to the Fluke 9000 Series and is not relevant to the 8522A address space.

LOCATION	SYSTEM FUNCTION
ADDRESS = 100C0	(INPUT) Reads Receiver Buffer Register of U26 (UART). This ADDRESS location uses the entire Data Bus, D0-D7.
ADDRESS = 100C1	(OUTPUT) Write to Transmitter Buffer Register of U26 (UART). This ADDRESS location uses the entire Data Bus, D0-D7.
ADDRESS = 100C2	READ ERROR STATUS OF THE UART (U26).
D7	Not Used
D6	Not Used
D5	Not Used
D4	(INPUT) Cal Switch (0 = closed, 1 = opened)
D3	(INPUT) Framing Error
D2	(INPUT) Overrun Error
D1	(INPUT) Parity Error
D0	(INPUT) Transmitter Register Empty
ADDRESS = 100C3	READ INTERRUPT VECTOR DATA
D7	(INPUT) Line Interrupt (Mark Interrupt)
D6	(INPUT) External Trigger Flag
D5	(INPUT) UART Data Received
D4	(INPUT) UART Transmit. Buffer Register Empty
D3	(INPUT) Remote Interrupt
D2	(INPUT) Power Failure
D1	Not Used
D0	Not Used
ADDRESS = 100C4	WRITE BUS STATE ENABLE
D7	(OUTPUT) Mark Enable: Enable Mark Interrupt
D6	(OUTPUT) External Trigger Enable
D5	(OUTPUT) UART Data Available Enable: Enable UART Interrupt
D4	(OUTPUT) Guard Trigger Enable
D3	(OUTPUT) Line Freq. (1 = 400, 0 = 50/60 Hz)
	NOTE If the $\overline{400/50,60}$ Hz signal is made high while the power line frequency is 60 or 50 Hz, then the $\overline{\text{RESET}}$ signal will soon be active, since the Reset circuitry dependson the correct frequency on signal FLINE.
D2	(OUTPUT Guard Mark Enable
D1	Not Used
D0	(OUTPUT) Remote LED
ADDRESS = 100C5	$\overline{\text{DIGIT}}$ — (This signal to Display Board)
ADDRESS = 100C6	$\overline{\text{SEGMENT}}$ — (This signal to Display Board)
ADDRESS = 100C7	$\overline{\text{SW}}$ — (This signal controls Front Panel display blanking.)
ADDRESS = 100C8	Not connected on PCB.
ADDRESS = 100C9	$\overline{\text{SOFT TRIG}}$ — (Software trigger for Guard Trigger of a reading)
ADDRESS = 100CA -100CF	Not Used

Table 5-2A. Digital PCB Troubleshooting with a Fluke 9000 Series (cont)

8522A = 4020 (U101) ADDRESS TABLE, REMOTE SECTION

The leading 1 in the addresses (e.g. 100xx) indicates an I/O signal to the Fluke 9000 Series and is not relevant to the 8522A address space.

LOCATION	SYSTEM FUNCTION
ADDRESS = 10080	(CONTROL) $\overline{\text{RRESET}}$: Initializes, sets, the flip-flop, U106, used in 4-wire handshake parallel operating mode.
ADDRESS = 10081	(OUTPUT) WS3: Writes data to output latches. Parallel = Bits 8-15. BCD = 5th digit and secondary function status. This ADDRESS location uses the entire DATA BUS, D0-D7.
ADDRESS = 10082	(OUTPUT) WS4: Writes data to output latches. Parallel = Not Used. BCD = Range and Primary Function Status. This ADDRESS location uses the entire DATA BUS, D0-D7.
ADDRESS = 10083	(OUTPUT) WS2: Writes data to output latches. Parallel = Bits 0-7. BCD = 3rd and 4th digits. This ADDRESS location uses the entire DATA BUS, D0-D7.
ADDRESS = 10084	(OUTPUT) WS1: Writes data to output latches. Parallel = Not Used. BCD = 1st and 2nd digits. This ADDRESS location uses the entire DATA BUS, D0-D7.
ADDRESS = 10085	(OUTPUT & CONTROL) WS0: Used for various outputs and internal control signals in both the BCD and Parallel operating modes. See schematic 8522A-1021 sheet 1 of 2. (Control) DB7 — BUSY CTL: BCD internal control signal. Helps determine the state of the external signal BUSY. (Output) DB6 — SAMPLE SYNC: BCD external signal. Indicates status of A/D sampling window. (Control) DB5 — BCD/$\overline{\text{PARA}}$ CTL: Controls the internal active switches which direct signals according to BCD or Parallel needs. (Output) DB4 — OVERLOAD: For BCD only. Indicates that the analog input (or ext. reference) is outside the measurement restrictions. or — $\overline{\text{PAR REM}}$. For parallel only. Indicates that the instrument is in remote rather than local. (Control) DB3 — $\overline{\text{REM}}$ $\overline{\text{INT}}$ $\overline{\text{EN}}$: Disables or enables remote interrupts via the active switches. (Output) DB2 — TRIGGER: For BCD only. Indicates that the instrument is in the external trigger mode (reading triggers, not command entry triggers). or — PFLG: For Parallel 3-wire only. Handshake line. DB1 — Not connected on the PCB. (Output) DB0 — OVERRANGE: For BCD only. Same as the most significant digit (the 1/2 digit) on the Front Panel display.
ADDRESS = 10086	Not connected on the PCB.
ADDRESS = 10087	(CONTROL) AUTO LATCH: Latches in data on the remote input latches (U109, U110), when the 8522A is in the BCD operating mode and the external signal AUTO CMD DEFEAT is at a logic high.
ADDRESS = 10088	Not connected on the PCB.
ADDRESS = 10089	(CONTROL) $\overline{\text{DATA VALID}}$: Resets the 4-wire handshake flip-flop, U106, when the remote outputs are valid. Causes the external signal, REQ B, to go high to indicate to the parallel controller that the 8522A data is valid. In the 3-wire handshake, the flip-flop is initialized or reset after an external PRESET is serviced.

Table 5-2A. Digital PCB Troubleshooting with the Fluke 9000 Series (cont)

8522A-4020 (U101) ADDRESS TABLE, REMOTE SECTION (cont)

LOCATION	SYSTEM FUNCTION
ADDRESS = 1008A	(CONTROL) $\overline{\text{READY}}$: Resets flip-flops, U106 and U123, which are used in BCD, 3-wire handshake parallel, and 4-wire handshake parallel operating modes for inputting commands to the 8522A. When the READY signal is toggled low, then the 8522A external signals go to a logic level indicating that the 8522A is ready to respond to input commands (e.g. the next full command in BCD or one word of the command in parallel).
ADDRESS = 1008B	(INPUT) $\overline{\text{STAT0}}$: Internal Status Vector DB7 — Not Used DB6 — POS: (BCD external signal) DB5 — PRDY: Parallel 4-wire handshake status. Parallel 3-wire, PRDY = 1 if external signal PRESET had a rising edge. DB4 — Status of S103-D DB3 — Status of S103-C DB2 — Status of external signal $\overline{\text{AUTO}}$ $\overline{\text{CMD}}$ $\overline{\text{DEFEAT}}$ DB1 — Status of S103-E DB0 — Not connected on PCB.
ADDRESS = 1008C	(INPUT) $\overline{\text{STAT1}}$: Internal Status Vector DB3 — Remote Interrupt Status (should be low immediately after READY is toggled.) DB2 — 4-wire Handshake Status DB1 — 3-wire & 4-wire Handshake Status (should be low immediately after READY is toggled.) DB0 — $\overline{\text{IN}}$/OUT, Used on 3-wire handshake (externally sourced signal).
ADDRESS = 1008D	(INPUT) $\overline{\text{RI1}}$: External command input latch contents. Parallel = Input Bits 8-15 BCD = DB7 — Not Used DB6 — Not Used DB5 — Not Used DB4 — Not Used DB3 — Not Used DB2 — $\overline{\text{Ohms}}$ DB1 — $\overline{\text{KOhms}}$ DB0 — $\overline{\text{VAC}}$ (Volts AC)
ADDRESS = 1008E	(INPUT) $\overline{\text{RI0}}$: External command input latch contents. Parallel = Input Bits 0-7. BCD = DB7 — $\overline{\text{10K RNG}}$ DB6 — $\overline{\text{1000 RNG}}$ DB5 — $\overline{\text{100 RNG}}$ DB4 — $\overline{\text{10 RNG}}$ DB3 — $\overline{\text{1 RNG}}$ DB2 — $\overline{\text{0.1 RNG}}$ DB1 — $\overline{\text{EXT REF}}$ (External Reference) DB0 — $\overline{\text{FILTER}}$
ADDRESS = 1008F	Not connected on PCB.

Table 5-3. Analog PCB Troubleshooting

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
	NOTE *The test in this table assumes that the instrument reponds to front panel commands and the fault is one of incorrect readings rather than a massive failure. A calibration adjustment procedure should be attempted prior to troubleshooting.*		
1	Remove any leads connected to the instrument input terminals.		
2	Select Math Program #1 (TEST), Test #1 (Analog).		
3	Step completely through the test, recording the number of any sub-tests that fail.		
4	Did any sub-test fail?	5	14
5	Did only one sub-test fail?	9	6
6	Compare the numbers of the failed sub-tests against the examples given in Table 5-7, comparing for a duplicate failure pattern.		
7	Does the failure pattern match one of those in the table?	8	9
8	Check the component indicated and its associated circuitry. Repair of replace as required then resume at step 2.		
9	Check the Analog Controller Ouput latches for the test(s) that failed using the applicable line(s) of Table 5-8.		
10	Are the latches in the states listed for that sub-test in the table?	13	11
11	Perform the analog controller latch test described in the Troubleshooting Paragraph.		
12	Do all the latches perform as required?	13	8
13	Trace the analog signal for the failed subtest through the applicable circuit(s) using the simplified schematics in Figures 5-1 through 5-7, and the typical test point voltages and Waveforms in Table 5-5. If the trouble is isolated to the Analog Controller or A/D Converter refer to the tests in the text portion of the troubleshooting section. Repair as required then resume at step 2.		
14	Is the trouble in low ohms (<20 Kohms)?	15	18
15	Check the low ohms circuit using Table 5-9.		
16	Are all circuit indications as shown in the Table?	18	17
17	Trace the signal path for the failed low ohms test trough the circuit using Table 5-5, typical Voltages and Waveforms. Repair as required then resume at step 15.		
18	Perform the Calibration Adjustment procedure given in Section 6 of the 8522A Calibration Manual.		
19	Can the Calibration Adjustment procedure be sucessfully completed?	21	20
20	Trace the defective adjustment circuit using the typical voltage and waveform in Table 5-5 and the schematics. Repair as required then resume at step 18.		
21	Troubleshooting the analog circuits is complete.		

Table 5-4. Error Codes

ERROR	DISPLAY	EXPLANATION
00	Blank	No Errors
01	Err01 HV	High Voltage present with ohms function selected
02	None	Syntax error during remote operation
03	Err03 NOVR	Numeric or register overflow
03	Err03 RTD	Failure of RTC algorithm to coverage
04	Err04 KEY	Invalid use of a control
05	Err05 FLTR	Cannot increase filter in ASYNC reading rate
06	Err06 ZERO	ZERO (Math Program #2) cannot be selected with the VAC or VA+D function
07	Err07 BOVR	Remote Input buffer overflow
08	or VXRF	External Reference input >±16.5V dc with Math Program #3 selected
09	ur VXRF	±0.5V dc difference between EXTERNAL REFERENCE HI and LO terminals with Math Program #3 selected.
10	HHHHH (function)	Normal input overrange
11	Err11 HDWR	Improper echo from A/D Microprocessor
12	rrtoo FAST	Reading rate too fast for selected filter and/or Math Program
14	Err14 ROM	ROM checksum error
15	Err15 RAM	RAM does not check out
16	Err16 LINE	Cannot determine line frequency at POWER ON
17	Err17 HDWR	Sync failure between the microprocessor and the A/D Converter
18	OPen INPUT	V/Ω INPUT terminals not open during Analog Test (Math Program #1)
22	Err22 HDWR	Error while measuring volts for ohms change
23	Err23 HDWR	Time error, incorrect response from A/D Converter
24	Err24 HDWR	Resync error: instrument controller to A/D Converter
25	Err25 HDWR	Ohms Reference Error
30	Err30 UART	No A/D response to microprocessor within time limits
31	Err31 UART	Microprocessor detects parity error
32	Err32 UART	Microprocessor detects overrun error
33	Err33 UART	Parity and overrun errors (Error Codes 31 & 32)
34	Err34 UART	Microprocessor detects framing error
35	Err35 UART	Parity and framing error (Error Codes 31 & 34)
36	Err36 UART	Overrun and framing errors (Error Codes 32 & 34)
37	Err37 UART	Parity, overrun, and framing errors (Error Codes 31, 32, & 34)
A1	ErrA1 GARD	Undefined interrupt at A/D
A3	ErrA3 GARD	Analog interrupt activated
A5	ErrA5 GARD	Parity, overrun, or framing error at A/D
A7	ErrA7 GARD	Illegal command at A/D

Table 5-5. Typical Voltages and Waveforms

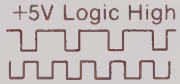
HI TP	LO TP	HI MNEMONIC	TYPICAL READING/WAVEFORM W/INPUT			REMARKS
			10V dc	10V ac @ 400 Hz	1KΩ	
		Analog				
102	103	DC INPUT	+10V dc	N/A	-1V dc	
104	103	MUX OUT	+10V dc	+10V dc	-1V dc	
202	207	BUF INP	+10V dc	+10V dc	-1V dc	
204	207	MEAS				Peak-≈2V+input V
205	207	ZERO				Base-≈-.5V+input V
206	207	BUF OUT	+10V dc	10V dc	+8V dc	
Q227-5	207		+12±2V dc	+12±2V dc	+10±2V dc	
Q234-5	207		+12±2V dc	+12±2V dc	+10±2V dc	
304	302	20V	N/A	N/A	20V dc	
305	302	0V	N/A	N/A	0V dc	
306	302	SRLO	N/A	N/A	-1.3V dc	
U403-7	402	+8V	N/A	+8.0V dc	N/A	
U403-4	402	-8V	N/A	-8.0V dc	N/A	
401	402	AC INP	N/A	10V dc	N/A	
403	402	BAL OUT	N/A		N/A	Peak≈0.9V above baseline
404	402	SQ RT	N/A	-0.57V dc	N/A	
405	402		N/A		N/A	Peak≈0.9V below baseline
502	501	$+V_{REF}$	+6.5V dc	+6.5V dc	+6.5V dc	
503	501	$-V_{REF}$	-6.5V dc	-6.5V dc	-6.5V dc	
505	501	A/D INPUT	+10V dc	+10V dc	+8V dc	
508	501	INT OUT	10100	10100	10000	Dependent upon A/D Input Synced to TP 509
603	604		+5V Logic High			-15V to gnd
602	604	$\overline{ALE}$				PERIOD=2.5 μS
605	604	2 MHz				2 MHz Clock
606	604	$\overline{INT}$	+5V Logic High	+5V Logic High	+15V to gnd	-15V to gnd
601	604	$\overline{RESET}$	+5V Logic High	+5V Logic High	+5V Logic High	-15V to gnd
703	705	+27V	+27.6 ±1.1V dc	+27.6 ±1.1V dc	+27.6 ±1.1V dc	
704	705	+15V	+15 ±0.6V dc	+15 ±0.6V dc	+15 ±0.6V dc	
706	705	-15V	-15 ±0.6V dc	-15 ±0.6V dc	-15 ±0.6V dc	
707	705	-27V	-27.6 ±1.1V dc	-27.6 ±1.1V dc	-27±1.1V dc	
701	702	-15 LH	+5 +0.2/-0.1V dc	+5 +0.2/-0.1V dc	+5 +0.2/-0.1V dc	-15V High -20V Low
		Digital				
1	2	Vcc	+5+0.2/-0.1V dc			
3	2	$\overline{RESET}$	+5V Logic High			
4	2		+5V Logic High			
5	2	$\overline{M\perp}$				
6	2	$\overline{INT}$				1 ms
7	2	ϕ				-.1 μs
8	2	$\overline{WAIT}$				

Table 5-6. Keyswitch Test

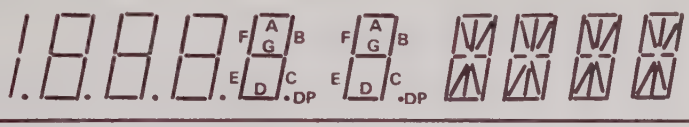
KEYSWITCH			
VDC (+/-)		D	DP
VAC (7)		C	DP
Ω2 WIRE (8)		DP	E
Ω4 WIRE (8)		G	E
nS (CE)		F	E
PROGRAMS IN USE/OFF		E	E
STATUS (MENU)		G	G
BURST SIZE		F	G
BURST LOCATION		E	G
AUTO RANGE (.)		D	G
▲RANGE (4)		C	G
▼RANGE (5)		DP	D
EXT/AUTP TRIGGER (6)		G	D
ARM BNC TRIGGER (EXP)		F	D
MANUAL TRIGGER		E	D
PROGRAM SELECTION		F	F
PROGRAM DATA		E	F
READING RATE▲(0)		D	F
READING RATE▼(1)		C	F
FILTER▼(2)		DP	C
FILTER▲(3)		G	C
LOCAL(/)		F	C
AT the Same Time: SHIFT and PROGRAM SELECTION		G and F	F
At the Same Time: RESET and nS (CE)		D and F	E

Table 5-7. Analog Test Failure Patterns

FAILED TEST 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	
X X X X X X X X X X X X X X X X	K102 remains energized
X	K102 does not energize
X X X	DC Buffer X1 amplifier
X X	DC Buffer X8 amplifier
X X X	DC Buffer X64 amplifier
X X X X X X X X X	Reference Voltage, R321, K103 remains energized, K101 does not energize
X X X X X X X X	K303 does not energize
X X	K303 remains energized
X X X X X X X X	K104 does not energize, K401 does not energize
X X X	AC Converter Range 1V (Q401, 408, 409, 421 on)
X X	AC Converter Range 10V (Q401, 402, 408, 409 on)
X X	AC Converter Range 100V (Q403, 404, 421 on)
X X	AC Converter Range 650V (Q405, 406, 407, 421 on)

Table 5-8. Analog Controller Latch Outputs

IC#	PIN#	MNEMONIC	ACTIVE STATE	ANALOG TEST NO. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
U618	2	$\overline{\text{X REF LO}}$	L	H ← H
	5	$\overline{\text{X REF HI}}$	L	H ← H
	6	$\overline{\text{DC X 1}}$	L	L H H L L H H H L L L L L L L L
	9	$\overline{\text{DC X 8}}$	L	H L H H H L H ← H
	12	$\overline{\text{DC X 64}}$	L	H H L H H H L L H ← H
	15	$\overline{\text{FAST DC}}$	L	H ← H
	16	$\overline{\text{SLOW DC}}$	L	L ← L
	19	No Connection	X	L ← L
U619	2	LOW DC	H	L L L H L ← L
	5	LOW OHMS	H	L ← L
	6	2T/4T SEL	H	L L L H H H H H L L L L H H H H
	9	No Connection	X	H ← H
	12	$\overline{\Omega\text{REF}}$	L	H ← H
	15	$\overline{\text{DC} + \Omega}$	L	L → L H ← H
	16	$\overline{\text{AC V}}$	L	H → H L ← L
	19	AC V	H	L → L H ← H
U620	2	$\overline{\text{SAC}}$	L	L ← L
	5	$\overline{\text{FAC}}$	L	H ← H
	6	10V AC	H	L → L H L L L H L L
	9	$\overline{\text{100V AC}}$	L	H → H L H H H L H
	12	$\overline{\text{10V AC}}$	L	H → H L H H H L H H
	15	$\overline{\text{1V AC}}$	L	H → H L L H H L L H H
	16	$\overline{\text{1 KV AC}}$	L	L → L H H H L H H H L
	19	K401	H	H ← H
U621	2	No Connection	X	L → L H L ← L
	5	No Connection	X	L ← L
	6	No Connection	X	L → L H L ← L
	9	$\overline{\text{HIGH OHMS}}$	L	H H H L L L L L H H H H L L L L
	12	$\overline{\text{200 K}\Omega}$	L	H H H L L L L H H H H H H L L L
	15	20 +200Ω	L	H ← H
	16	$\overline{\text{2 K}\Omega}$	L	H → H L H ← H
	19	$\overline{\text{OHMS CLAMP}}$	L	L → L H L ← L

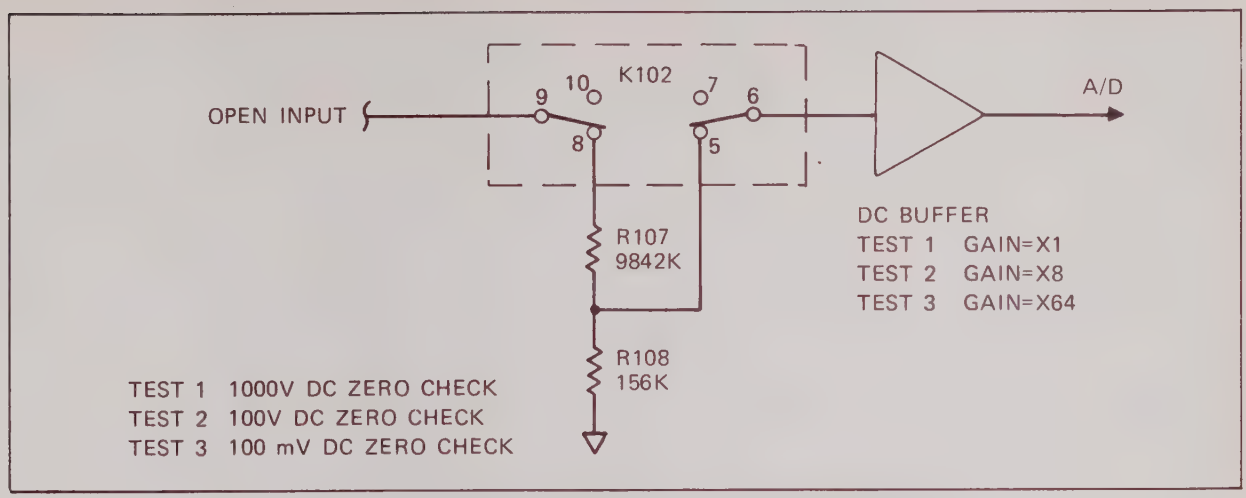
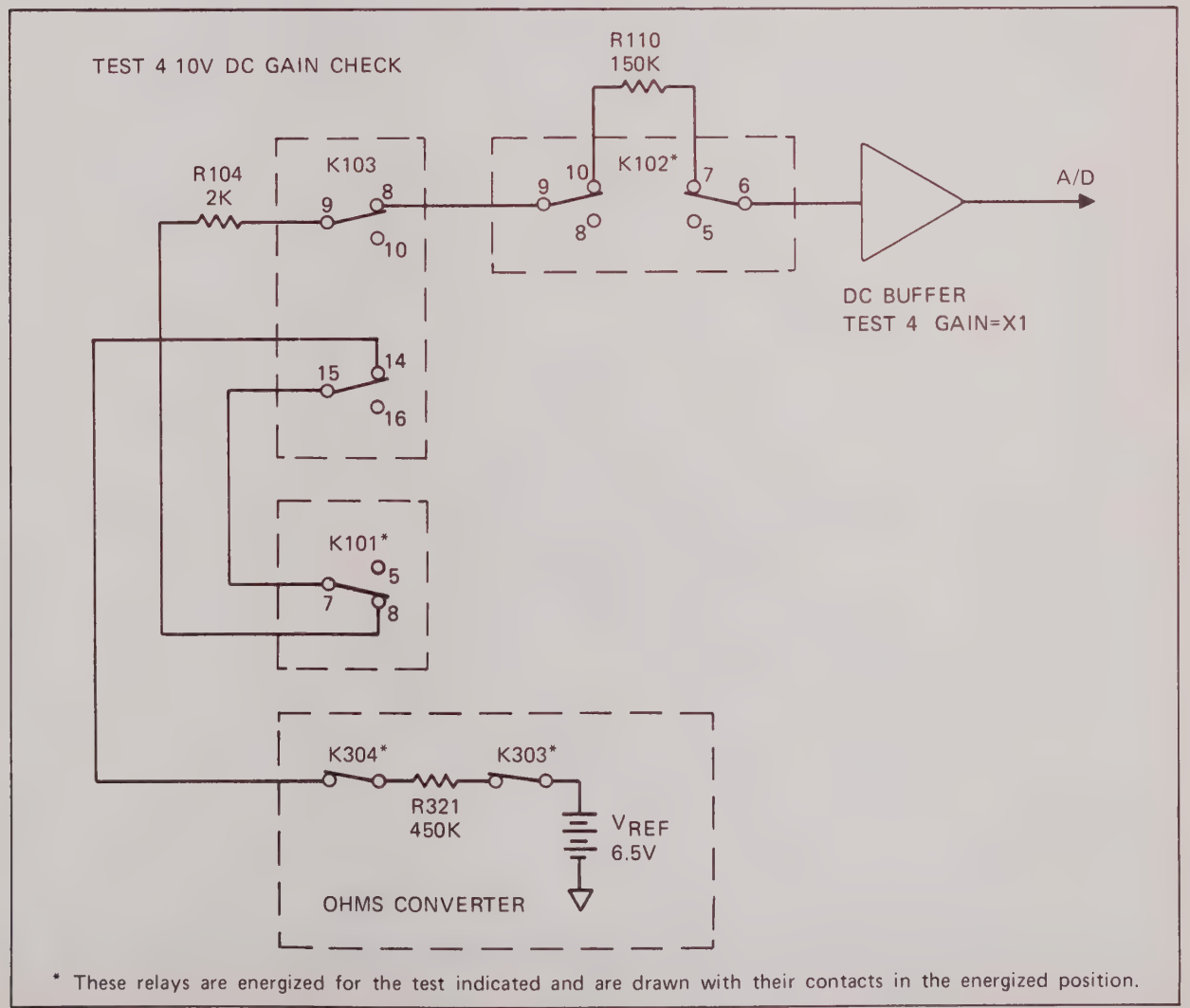
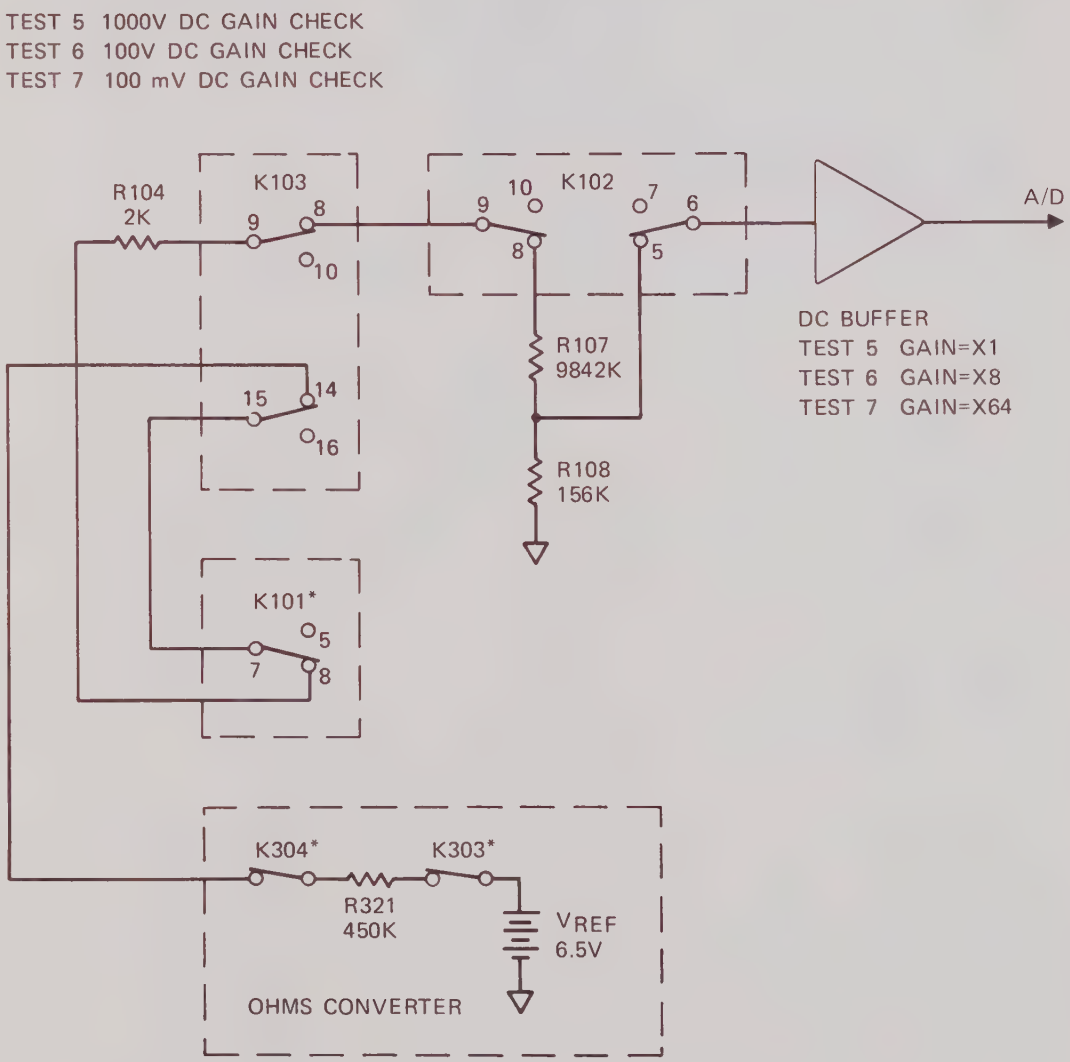


Figure 5-1. Analog Self Tests #1, 2, 3 Simplified Schematic



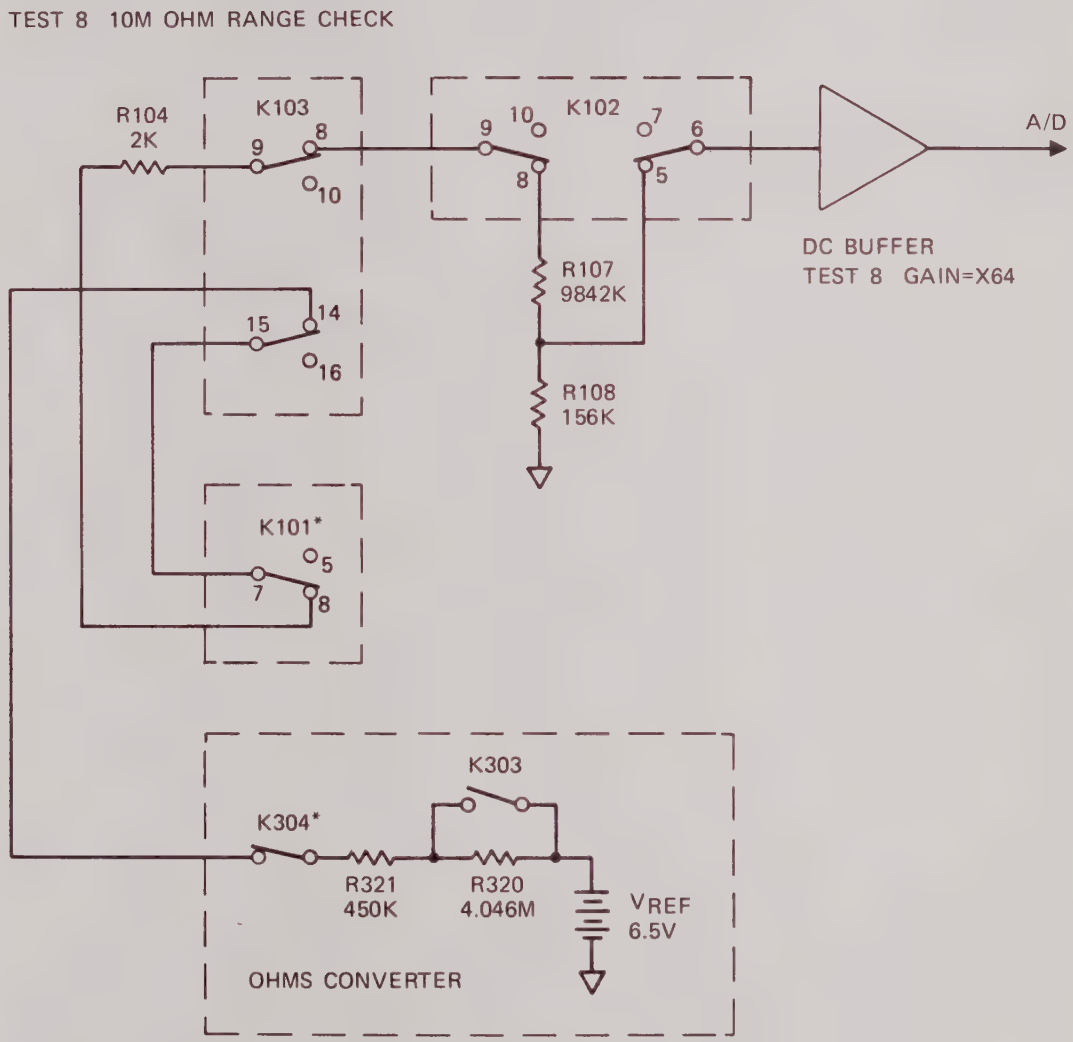
* These relays are energized for the test indicated and are drawn with their contacts in the energized position.

Figure 5-2. Analog Self Test #4 Simplified Schematic



* These relays are energized for the tests indicated and are drawn with their contacts in the energized position.

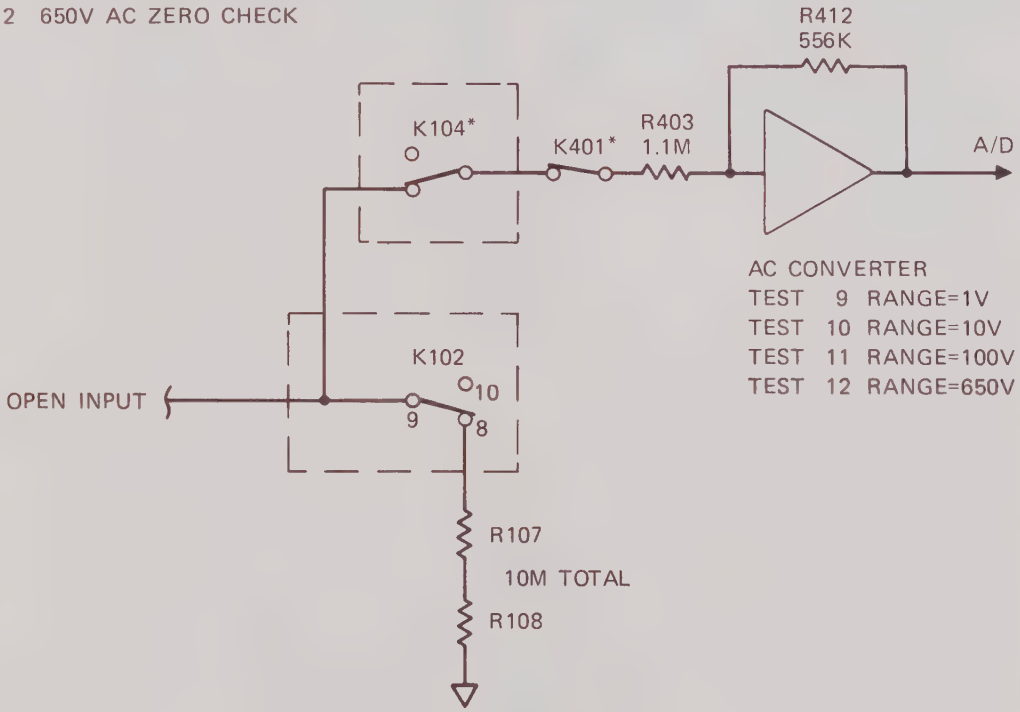
Figure 5-3. Analog Self Tests #5, 6, 7 Simplified Schematic



* These relays are energized for the test indicated and are drawn with their contacts in the energized position.

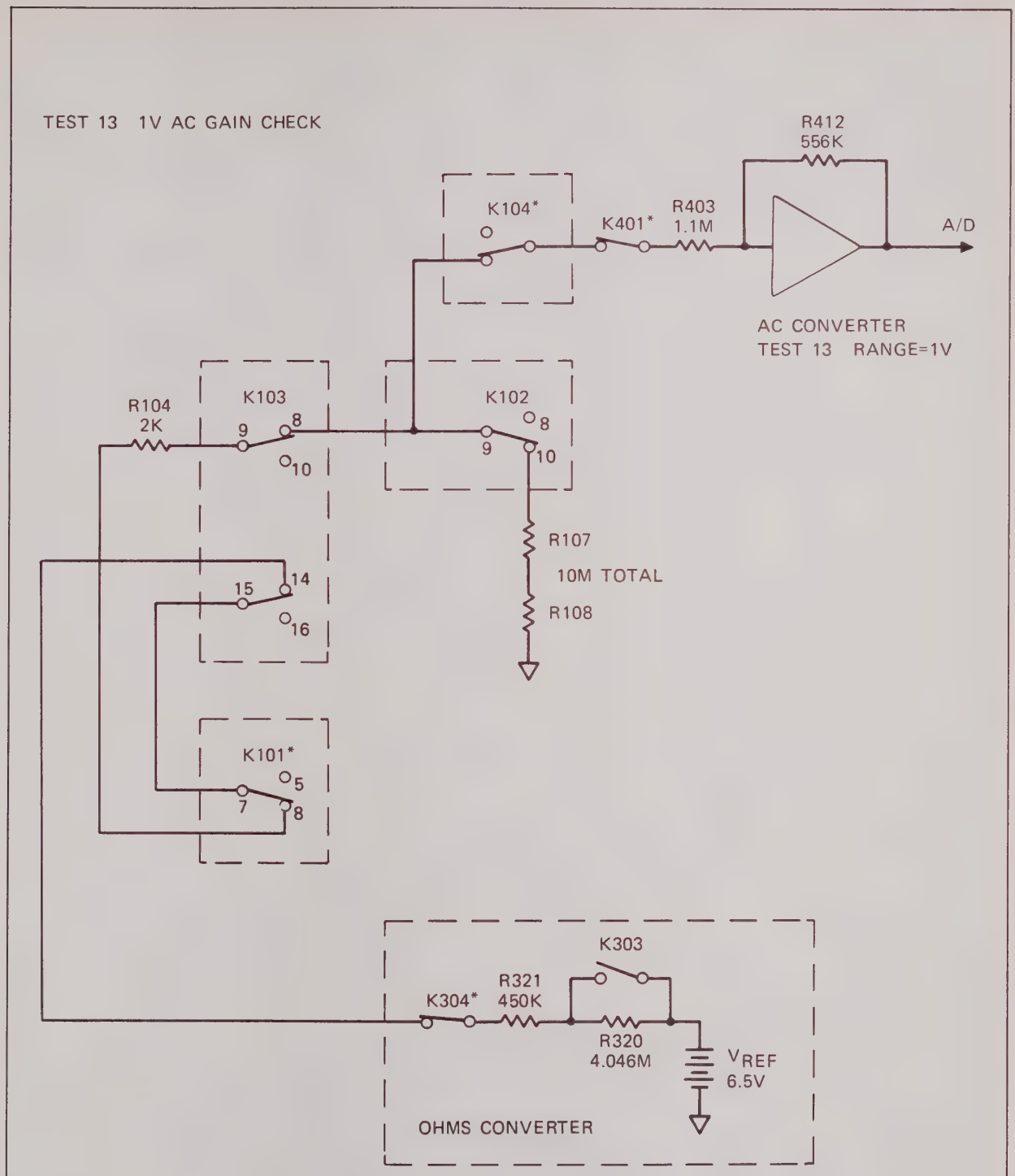
Figure 5-4. Analog Self Test #8 Simplified Schematic

TEST 9 1V AC ZERO CHECK
TEST 10 10V AC ZERO CHECK
TEST 11 100V AC ZERO CHECK
TEST 12 650V AC ZERO CHECK



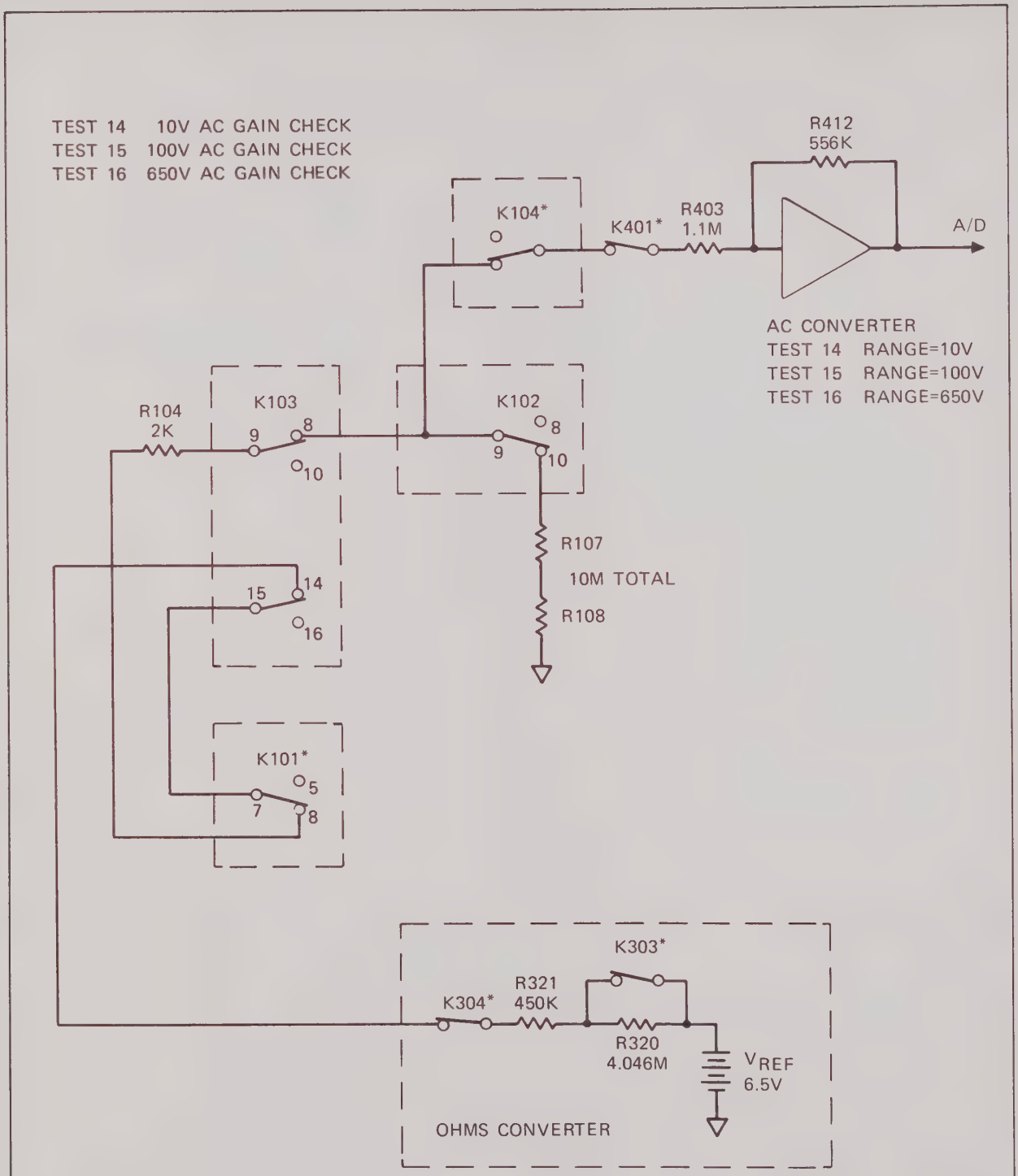
* These relays are energized for the tests indicated and are drawn with their contacts in the energized position.

Figure 5-5. Analog Self Tests #9, 10, 11, 12 Simplified Schematic



* These relays are energized for the test indicated and are drawn with their contacts in the energized position.

Figure 5-6. Analog Self Test #13 Simplified Schematic



* These relays are energized for the tests indicated and are drawn with their contacts in the energized position.

Figure 5-7. Analog Self Tests #14, 15, 16 Simplified Schematic

Table 5-9. Low Ohms Tests

	4 TERMINAL 10Ω	4 TERMINAL 100Ω	4 TERMINAL 1000Ω	4 TERMINAL 10 KΩ
K101	OFF	OFF	OFF	OFF
K102	ON	ON	ON	ON
K103	ON	ON	ON	ON
K104	OFF	OFF	OFF	OFF
Q103	OFF	OFF	OFF	OFF
Q104	ON	ON	ON	ON
Q106	OFF	OFF	OFF	OFF
Q107	OFF	OFF	OFF	OFF
Q108	OFF	OFF	OFF	OFF
GAIN DC BUFFER	64	8	8	8
Q236	OFF	OFF	OFF	OFF
Q237	OFF	ON	ON	ON
Q238	ON	OFF	OFF	OFF
Q308	OFF	OFF	OFF	OFF
Q305	ON	ON	OFF	OFF
Q306	OFF	OFF	ON	OFF
K301	OFF	OFF	ON	OFF
K302	ON	ON	OFF	OFF
K304	OFF	OFF	OFF	OFF

Table 5-10. Analog Controller Latch Tests

TESTS	S601 Switch Number				LOCATION
	1	2	3	4	
Port 2	OFF	OFF	OFF	OFF	U601-21-24, 35-38
Port 1	OFF	OFF	OFF	ON	U601-27-34
U617	OFF	OFF	ON	OFF	U617-2, 5, 7, 10, 12
U621	OFF	OFF	ON	ON	U621-2, 5, 6, 9, 12, 15, 16, 19
U620	OFF	ON	OFF	OFF	U620-2, 5, 6, 9, 12, 15, 16, 19
U619	OFF	ON	OFF	ON	U619-2, 5, 6, 9, 12, 15, 16, 19
U618	OFF	ON	ON	OFF	U618-2, 5, 6, 9, 12, 15, 16, 19
U604	OFF	ON	ON	ON	U604-1-11, 13

Table 5-11. Analog Controller UART Test

PORT 1 BYTE	U601 (PORT 1) 29 (2)	28 (1)	27 (0)	RESPONSE
0000 0001	L	L	H	The interrupt mask has been set for local echo and even parity (data 10 Hex) and a data byte (A9 Hex) written into the UART. The software has written 01 Hex into Port 1 and is waiting for the TBE bit (U602-22) to be set true.
0000 0010	L	H	L	After receipt of TBE the software writes a 02 Hex in Port 1 and waits for DAV (U602-19) to be set true.
0000 0011	L	H	H	After receipt of DAV the software writes 03 Hex in Port 1 and compares E3 Hex with the UART status, i.e. U602 pins 24 (EOC), 22 (TBE), and 19 (DAV) high, pins 13 (PE), 14 (FE), and 15 (OR) low, and U601 pins 18 (D6) and 19 (D7) are high. If they are the same the test continues, otherwise it stops with 03 Hex in the Port.
0000 0100	H	L	L	If the status byte matches, the software writes 04 Hex into Port 1 and compares the UART data to A9 Hex. If they are the same the test continues, otherwise it stops with 04 Hex in the Port.

Table 5-12. Analog Controller Interrupt Test

PORT 1 BYTE	U601 (PORT 1) 30 (3)	29 (2)	28 (1)	27 (0)	RESPONSE
0000 0100	L	H	L	L	The software writes 04 Hex in Port 1 and 11 Hex on the data lines for the interrupt mask register (U607) for local echo, even parity, and DAV interrupt enable. Local echo strobes the UART write line (U602-23) and a data byte is transferred out on U602-25 to the digital circuitry and then back on U602-20. The software then waits for U601-6 (INT) to go low before going to the next step.
0000 0101	L	H	L	H	When INT goes low the software writes 05 Hex in Port 1 and compares the interrupt vector with F1 Hex to insure that U601 pins 16, 17, 18, and 19 are high during the interrupt vector strobe (U604-7) and that only the DAV interrupt is active. If they compare the test continues, otherwise it stops with 05 Hex in the port.
0000 0110	L	H	H	L	If there is a match the software writes 06 Hex in port 1 and 10 Hex on the data lines to disable the interrupt. It then verifies that INT on U601-6 goes high.
0000 0111	L	H	H	H	When INT goes high the software writes 07 Hex in Port 1 and F4 Hex in the interrupt mask register (U607). It then strobes the UART write line (U602-23) then clocks U608-9 high through U614-12 and U610-3. When INT (U601-6) goes low it continues with the test, otherwise it stops with 07 Hex in the Port.
0000 1000	H	L	L	L	When INT goes low the software writes 08 Hex in Port 1 and compares the interrupt vector with F4 Hex to verify that U601 pins 16, 17, 18, and 19 are high during the interrupt vector strobe (U604-7) and that only the TRIGGER interrupt (U608-9) is active. If they compare the test repeats itself, otherwise it stops with 08 Hex in the Port.

Table 5-13. UART and Interrupt Troubleshooting Procedures

STEP NO.	ACTION	GO TO STEP FOR CORRECT RESPONSE	
		YES	NO
	NOTE *The first 9 steps are the same regardless of the test that failed.*		
1	Check the CPU (U601) for defective pins on the ports or outputs. Repeat the failed test.		
2	Does the test operate satisfactorily?	21	3
3	Check the IC's Connected to the data bus for shorted or defective pins. They are U603, U607, U611, U612, U617, U618, U619, U620, and U621. Repeat the failed test.		
4	Does the test operate satisfactorily?	21	5
5	Check the reset circuitry (U605, U609, and U614), that initiates the test by forcing a reading of the program. Repeat the failed test.		
6	Does the test operate satisfactorily?	21	7
7	Check the address decoding circuitry (U603, U604, U613, and U614). Repeat the failed test.		
8	Does the test operate satisfactorily?	21	9
9	Check the UART (U602).		
10	Does the test operate satisfactorily?	21	11
11	Is the port locked in 02 Hex during the UART Test?	12	14
12	Check U607, U610, and U615. Repeat the failed test.		
13	Does the test operate satisfactorily?	21	20
14	Is the port locked in either 03 Hex or 04 Hex during the UART Test or in one of the Interrupt tests?	15	16
15	Check the UART Transmit/Receive circuitry (U609, U610, U612, and U615). Repeat the failed test.		
16	Does the test operate satiafactorily?	21	20
17	Is the port locked in any of the Interrupt Tests?	18	20
18	Check the Interrupt circuitry (U607, U608, U612, and U613). Repeat the failed test.		
19	Does the test operate satisfactorily?	21	20
20	All checks have been completed; however, the instrument still does not perform the test satisfactorily. Repeat all checks looking for a failure that took place during the checks. Check for open or shorted land patterns and other tests of this type.		
21	Troubleshooting of the UART and Interrupt circuits is complete.		

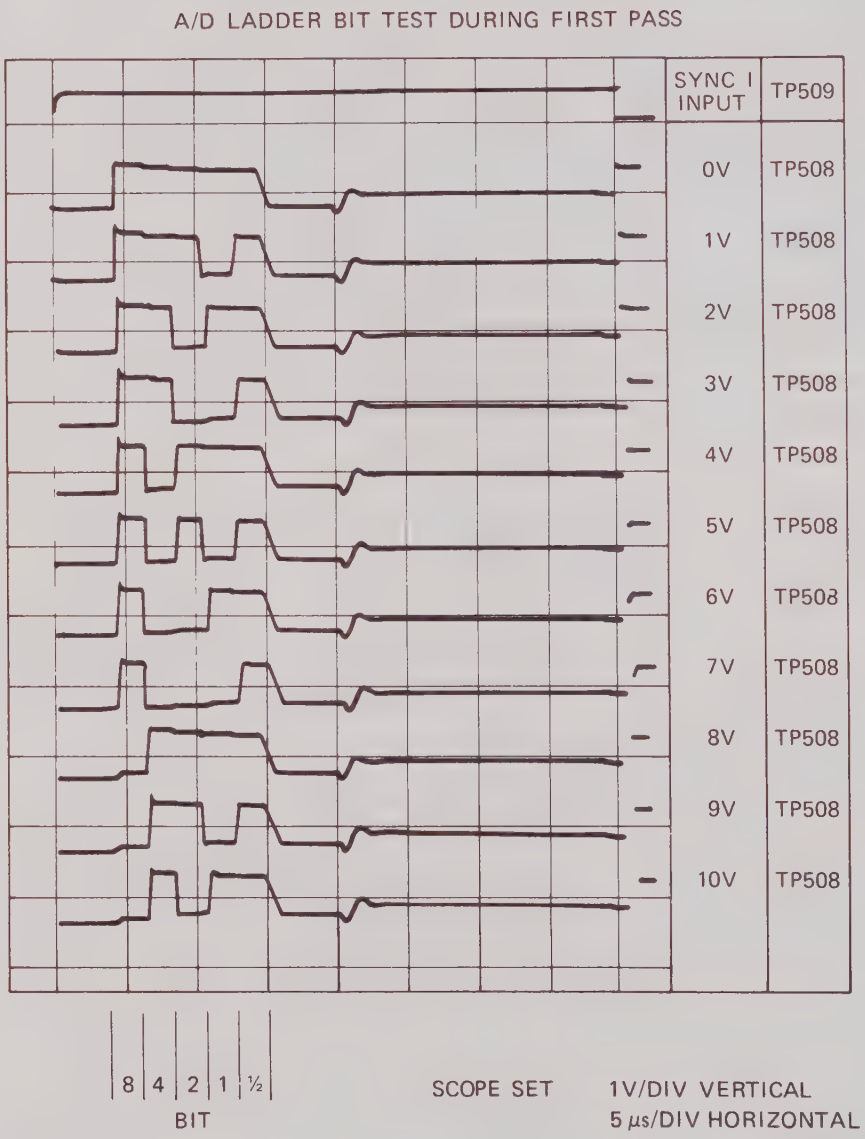


Figure 5-8. A/D Converter Test

Section 6
List of Replaceable Parts

TABLE OF CONTENTS

ASSEMBLY NAME	TABLE NO.	TABLE PAGE	FIGURE NO.	FIGURE PAGE
8522A Final Assembly	6-1	6-3	6-1	6-5
A1 Display PCB Assembly	6-2	6-8	6-2	6-10
A2, Digital (Controller) PCB Assembly	6-3	6-11	6-3	6-17
A2A1 Parallel/BCD, I/O PCB Assembly	6-4	6-18	6-4	6-18
A3 Analog PCB Assembly	6-5	6-19	6-5	6-31
A3A1 Reference Module PCB Assembly	6-6	6-33	6-6	6-33
A4 Transformer Assembly	6-7	6-34	6-1	6-35

6-1. INTRODUCTION

6-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accopmanying illustration.

6-3. Parts lists include the following information:

1. Reference Designation.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufactures. (See Section 7 for Code-to-Name list.)

5. Manufacture's Part Number.

6. Total Quantity of components per assembly.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked (see paragraph 6-7). In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the items in that particular assembly.

6-4. HOW TO OBTAIN PARTS

6-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. or its authorized representatives by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced be a new or improved part, the replacement will be accompied by an explanatory note and installation instructions, if necessary.

6-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.

2. FLUKE Stock Number.

3. Description.

4. Reference Designation.

5. Printed Circuit Board Part Number and Revision Letter.

6. Instrument Model and Serial Number.

6-7. A Recommended Spare Parts Kit for your basic instrument is available from the factory. This kit contains those itmes listed in the REC QTY comumn of the parts list in the quantities recommended.

6-8. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representatives. Prices are also available in a Fluke Replacement Parts Catalog, which is available on request.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 6-1. 8522A Final Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
	FINAL ASSEMBLY, 8522A FIGURE 6-1 (8522A-T&B, 5001)						
A1Ø	DISPLAY PCB ASSEMBLY	516625	89536	516625	1		
A2Ø	DIGITAL PCB ASSEMBLY	608729	89536	608729	1		
A3Ø	ANALOG PCB ASSEMBLY	496836	89536	496836	1		
A4	TRANSFORMER ASSEMBLY	496869	89536	496869	1		
F1	FUSE, SLO BLO, 1/2 AMP	109322	71400	MDL1-2	1	5	
FL1	FILTER, LINE	321273	05245	3EF2	1		
H1	NUT, HEX, 1/4-28	110619	89536	110619	2		
H2	NUT, HEX, 4-40	147611	89536	147611	2		
H3	SCREW, PHP, 4-40 X 3/16	129882	89536	129882	2		
H4	SCREW, FHP, 8-32 X 1/2	256206	89536	256206	8		
H5	SCREW, FHP, 8-32 X 3/8	114116	89536	114116	8		
H6	SCREW, PHP, 4-40 X 1/4	256156	89536	256156	8		
H7	SCREW, PHP, 6-32 X 1/2	177030	89536	177030	4		
H8	SCREW, FHP, 6-32 X 1/4	320093	89536	320093	12		
H9	SCREW, PHP, 6-32 X 1/4	385401	89536	385401	40		
H10	SCREW, PHP, 6-32 X 3/8	334458	89536	334458	4		
H11	SCREW, PHP, 6-32 X 5/16	424713	89536	424713	9		
H12	SCREW, PHP, 8-32 X 5/8	293324	89536	293324	4		
H13	SCREW, SOCKET, 8-32 X 3/8	295105	89536	295105	4		
H14	WASHER, LOCK, #6	403923	89536	403923	42		
H15	WASHER, FLAT, #6	110270	89536	110270	1		
H16	WASHER, LOCK, 1/4	110817	89536	110817	2		
H17	WASHER, LOCK, INT TOOTH, #8	110320	89536	110320	4		
H18	WASHER, LOCK #4	147603	89536	147603	4		
MP1	BAIL, INSTRUMENT	523571	89536	523571	2		
MP2	BINDING POST	225615	20584	3575	1		
MP3	BULKHEAD, CENTER	491100	89536	491100	1		
MP4	BUTTON, GREY	472316	89536	472316	2		
MP5	CHASSIS, ANALOG ASSEMBLY	496802	89536	496802	1		
MP6	CHASSIS, SIDE, LEFT	491084	89536	491084	1		
MP7	CHASSIS, SIDE, RIGHT	491092	89536	491092	1		
MP8	CLAMP, CABLE	100081	95987	3/8-3NA	1		
MP9	CLAMP, CABLE	101352	71400	5681-15	1		
MP10	CLAMP, CABLE	165951	31827	3-4-1	1		
MP11	CONNECTOR, CABLE (NOT SHOWN)	369231	89536	369231	1		
MP12	CONNECTOR KIT, AMP	449092	89536	449092	2		
MP13	CONNECTOR, 37 PIN (NOT SHOWN)	235093	71785	DC37-P	1		
	HOOD (NOT SHOWN)	615153	00779	1-207908-0	1		
MP14	CONNECTOR, 50 PIN (NOT SHOWN)	306811	71785	DC50-P	1		
	HOOD (NOT SHOWN)	615161	00779	1-207908-3	1		
MP15	CONTACT, CRIMP (NOT SHOWN)	369280	89536	369280	7		
MP16	CONTACT, SOLDER (NOT SHOWN)	396298	89536	396298	7		
MP17	CORNER HANDLE, FRONT	394296	89536	394296	2		

Table 6-1. 8522A Final Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
MP18	CORNER, PLASTIC	394338	89536	394338	2		
MP19	COVER PLATE, TRANSFORMER	496893	89536	496893	1		
MP20	COVER, BOTTOM	491191	89536	491191	1		
MP21	COVER, BOTTOM GUARD	490979	89536	490979	1		
MP22	COVER, TOP	491183	89536	491183	1		
MP23	COVER, TOP GUARD	490987	89536	490987	1		
MP24	DECAL	394379	89536	394379	4		
MP25	DECAL, FRONT PANEL	605758	89536	605758	1		
MP26	DECAL, POWER ON/OFF	523704	89536	523704	1		
MP27	DECAL, SERIALIZATION	472795	89536	472795	1		
MP28	DECAL, SIDE TRIM	525998	89536	525998	2		
MP29	FOOT, BAIL STAND	527473	89536	527473	4		
MP30	FOOT, REAR PANEL	307363	89536	307363	4		
MP31	GROMMET, RUBBER	100073	83330	2149	1		
MP32	INSERT, FRONT PANEL	496760	89536	496760	1		
MP33	INSULATOR, FASTENER	372342	89536	372342	6		
MP34	INSULATOR, SPACER	372334	89536	372334	6		
MP35	LENSE, DISPLAY	534479	89536	534479	1		
MP36	LUG, SOLDER	101022	89536	101022	2		
MP37	PANEL, FRONT	491175	89536	491175	1		
MP38	PANEL, REAR	608737	89536	608737	1		
MP39	POST, BINDING, BRASS	225623	20584	3576	1		
MP40	TIE, CABLE	172080	89536	172080	1		
MP41	TOOL, ADJUSTMENT (NOT SHOWN)	520825	89536	520825	1		
MP42	BUTTON, GREEN	502690	89536	502690	1		
S1	SWITCH, POWER	507871	71468	SCH.1XF.0003-01	1	1	
TM1	INSTRUCTION MANUAL, 8522A	629196	89536	629196	1		
W1	CABLE, BNC ASSEMBLY	630822	89536	630822	1		
W2	CABLE, JUMPER	474148	89536	474148	1		
W3	CABLE, POWER SW	496877	89536	496877	1		
W4	CABLE, REAR INPUT	496885	89536	496885	1		
W5	CORD SET, 3 WIRE (NOT SHOWN)	284174	89536	284174	1		
XF1	FUSEHOLDER				1		
	BODY	375188	89536	375188			
	CAP	460238	89536	460238			
	RECOMMENDED SPARE PARTS KIT	653451	89536	653451			

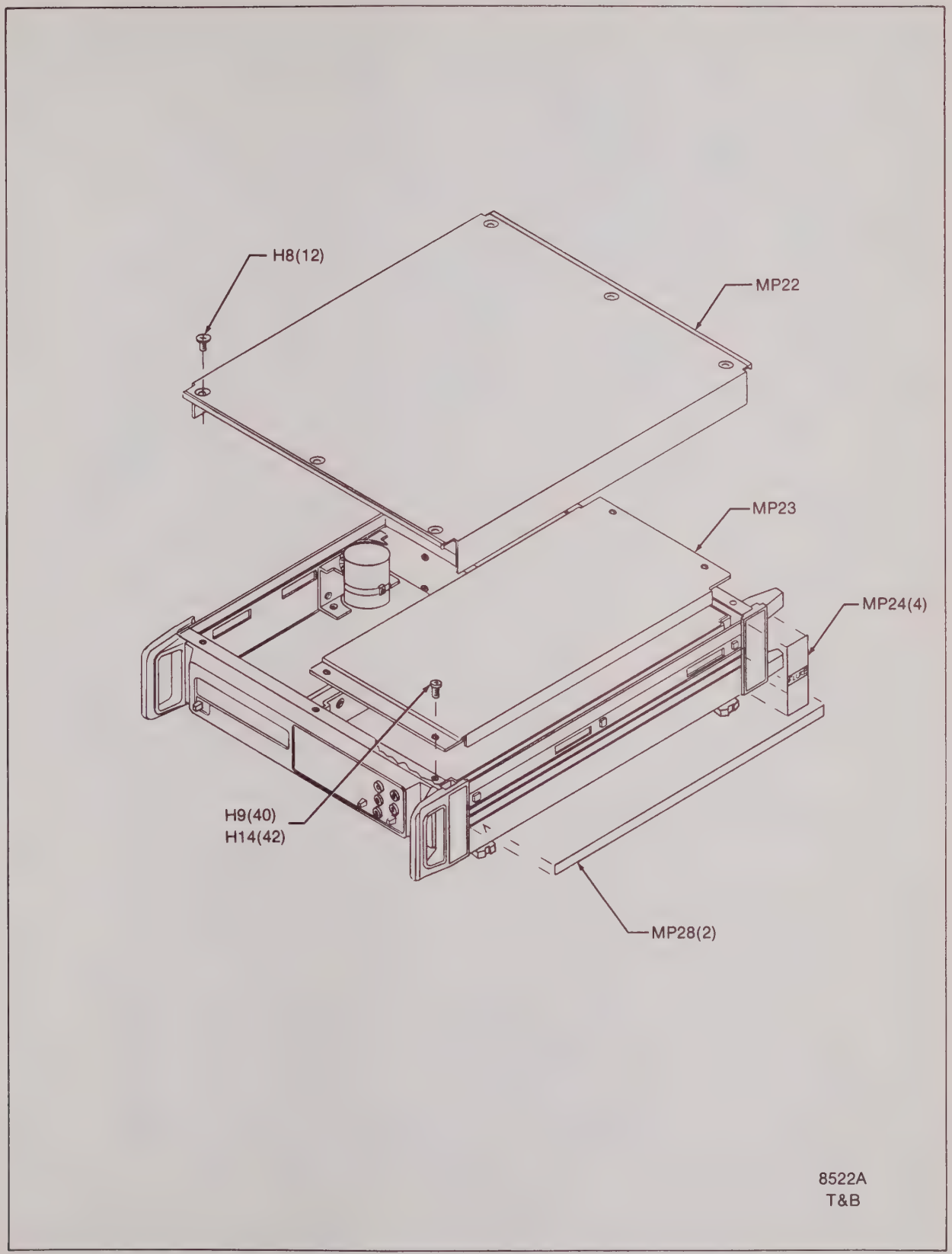


Figure 6-1. 8522A Final Assembly

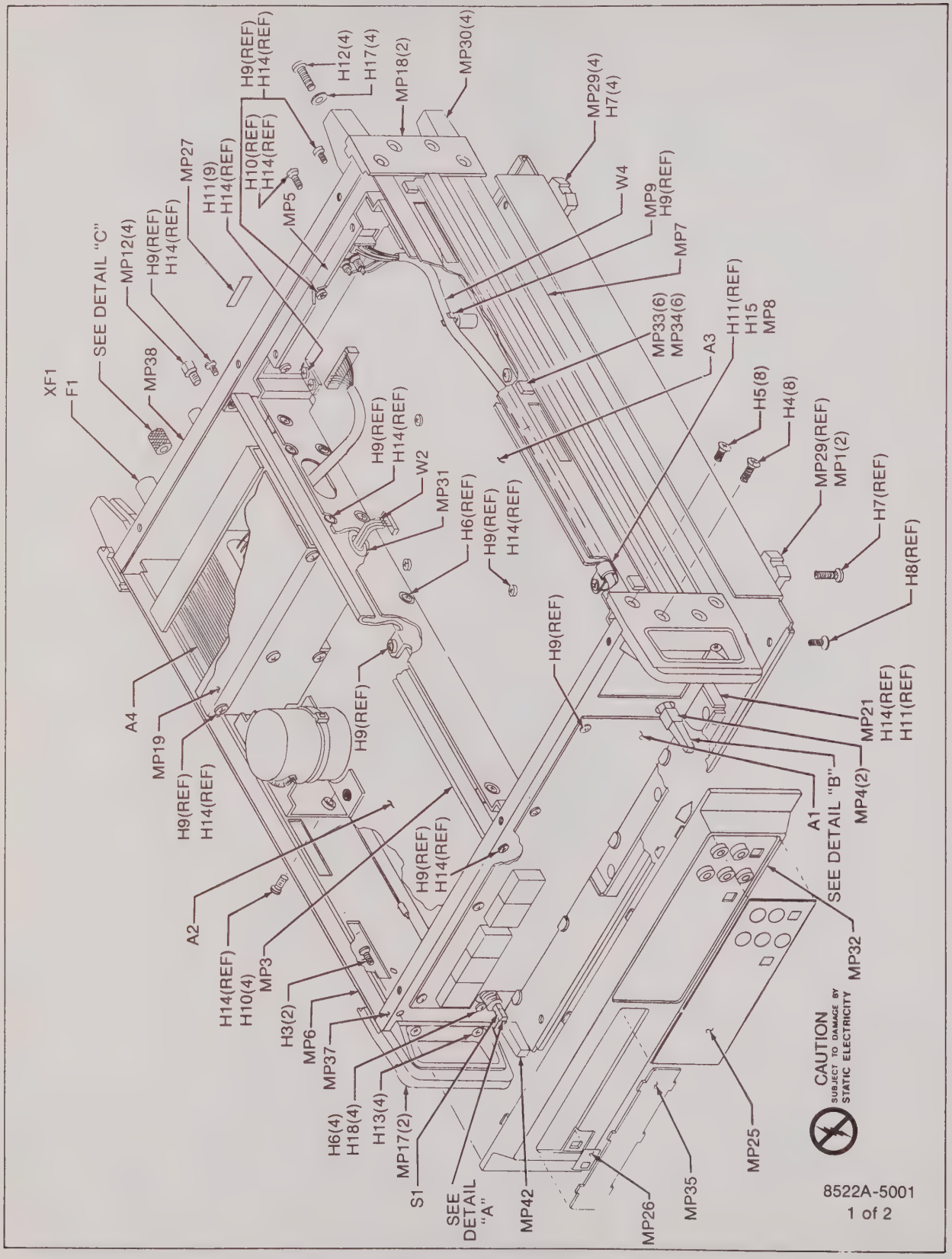


Figure 6-1. 8522A Final Assembly (cont)

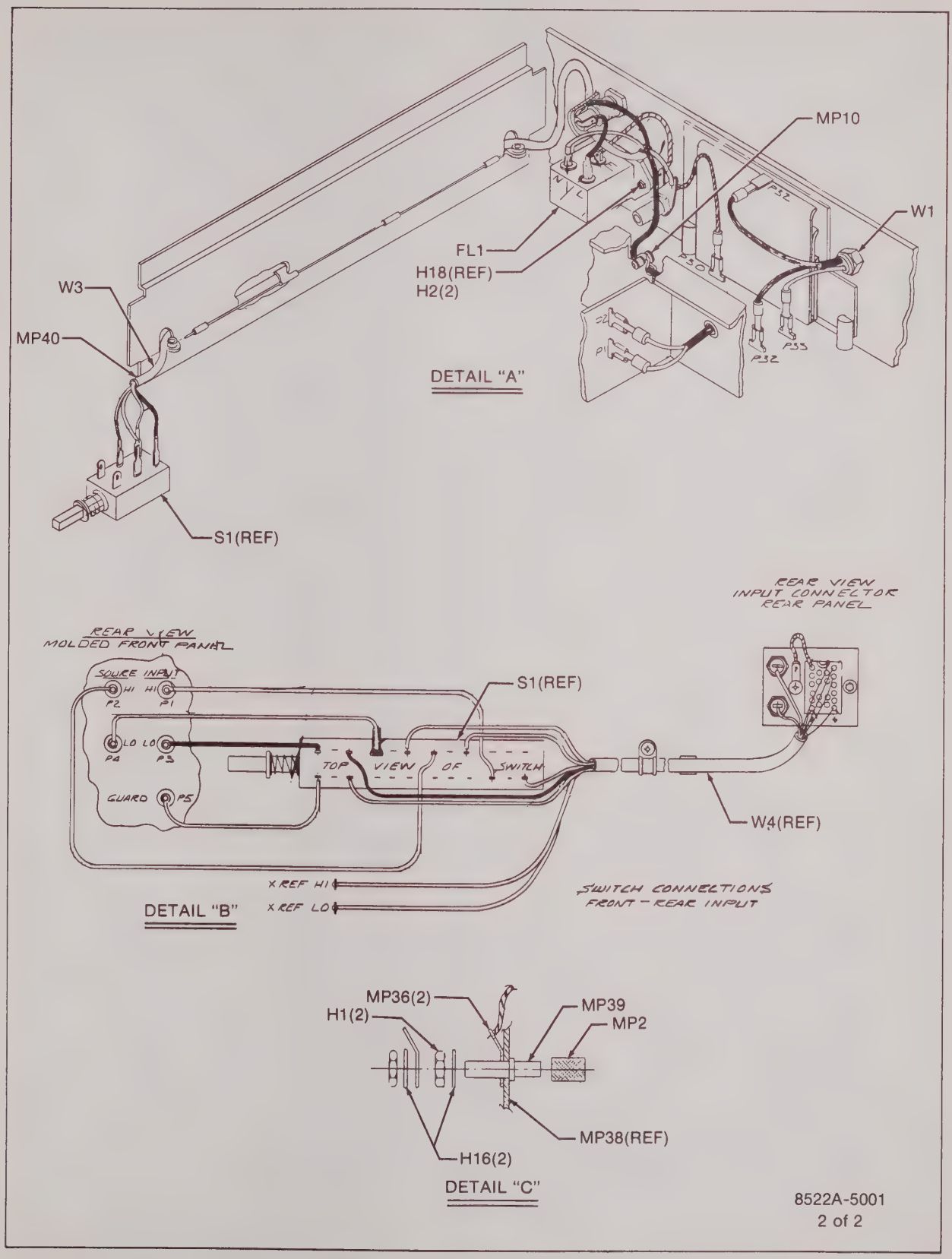


Figure 6-1. 8522A Final Assembly (cont)

Table 6-2. A1 Display PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A1Ø	DISPLAY PCB ASSEMBLY FIGURE 6-2 (8520A-4011T)	516625	89536	516625	REF		
CR1	DIODE, ZENER, 3.9V	113316	07910	1N748Z	1	1	
CR2	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	1	1	
DS7	LIGHT EMITTING DIODE	504761	29083	MV57124	1	1	
J1	CABLE	500975	89536	500975	1		
MP1	PUSHBUTTON, GRAY (TO S1-S3, S5, S8-S10, S16, S18-S24)	401307	89536	401307	15		
MP2	PUSHBUTTON, BLUE (TO S7)	406736	89536	406736	1		
MP3	PUSHBUTTON (TO S12,S13)	531525	89536	521525	2		
MP4	FILTER, LIGHT	578617	89536	578617	2		
MP5	SPACER, DIODE (TO DS7)	434399	89536	434399	1		
R1	RES, DEP. CAR, 270 +/-5%, 1/4W	348789	80031	CR251-4-5P270E	1		
R2	RES, DEP. CAR, 200 +/-5%, 1/4W	368779	80031	CR251-4-5P200E	1		
RN1	RESISTOR NETWORK, 2.7K, 10-PIN	484303	89536	484303	1	1	
RN2	RESISTOR NETWORK, 1K, 8-PIN	414557	89536	414557	3	1	
RN3	RESISTOR NETWORK, 430, 16-PIN	484295	89536	484295	2	1	
RN4	RESISTOR NETWORK, 81, 16-PIN	478859	89536	478859	2	1	
RN6	RES, FXD, 430, 16-PIN	484295	89536	484295	REF		
RN7	RESISTOR NETWORK, 1K, 8-PIN	414557	89536	414557	REF		
RN8	RESISTOR NETWORK, 1K, 8-PIN	414557	89536	414557	REF		
RN9	RESISTOR NETWORK, 81, 16-PIN	478859	89536	478859	REF		
S1	SWITCH, MOMENT, VDC	507319	89536	507319	18		
S2	SWITCH, MOMENT, VAC	507319	89536	507319	REF		
S3	SWITCH, MOMENT (OHMS, 2-T)	507319	89536	507319	REF		
S4	SWITCH, MOMENT (OHMS 4-T)	507335	89536	507335	4		1
S5	SWITCH, MOMENT (NS)	507319	89536	507319	REF		
S6	SWITCH, MOMENT (PROG IN USE)	507335	89536	507335	REF		1
S7	SWITCH, MOMENT (RESET)	507319	89536	507319	REF		
S8	SWITCH, MOMENT (STATUS/MENU)	507319	89536	507319	REF		
S9	SWITCH, MOMENT (BURST SIZE)	507319	89536	507319	REF		
S10	SWITCH, MOMENT (BURST LOC)	507319	89536	507319	REF		
S11	SWITCH, MOMENT (AUTO RANGE)	525170	89536	525170	1		1
S12	SWITCH, MOMENT (UP)	507319	89536	507319	REF		
S13	SWITCH, MOMENT (DOWN)	507319	89536	507319	REF		
S14	SWITCH, MOMENT (EXT/AUTO)	507335	89536	507335	REF		1
S15	SWITCH, MOMENT (ARM BNC)	507335	89536	507335	REF		1
S16	SWITCH, MOMENT (MANUAL)	507319	89536	507319	REF		
S17	SWITCH, ORANGE (SHIFT)	524082	89536	524082	1		1
S18	SWITCH, MOMENT (MATH SEL)	507319	89536	507319	REF		
S19	SWITCH, MOMENT (MATH DATA)	507319	89536	507319	REF		
S20	SWITCH, MOMENT (RR FASTER)	507319	89536	507319	REF		
S21	SWITCH, MOMENT (RR SLOWER)	507319	89536	507319	REF		
S22	SWITCH, MOMENT (FILT FASTER)	507319	89536	507319	REF		
S23	SWITCH, MOMENT (FILT SLOWER)	507319	89536	507319	REF		
S24	SWITCH, MOMENT (LOCAL)	507319	89536	507319	REF		
U1Ø	IC, TTL, LO-PWR, SCHTTKY, OCTAL "D" TYPE	454892	01295	SN74LS273N	1	1	
U2	IC, QUAD, COMMON EMITTER/OPEN COLLECTOR	454306	56289	UNL2064B	2	1	
U3	IC, QUAD, COMMON EMITTER/OPEN COLLECTOR	454306	56289	UNL2064B	REF		

Table 6-2. A1 Display PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
U5Ø	IC, C-MOS, HEX OPEN DRAIN BUFFERS	473389	12040	MM74C906N	2	1	
U6Ø	IC, C-MOS, TRI-STATE, HEX NON-INV BFFRS	407759	12040	MM80C97N	1	1	
U7Ø	IC, C-MOS, HEX OPEN DRAIN BUFFERS	473389	12040	MM74C906N	REF		
U9Ø	IC, C-MOS 8-BIT ADDRESSABLE LATCH 16-PIN	453258	02735	CD4099BE	2	1	
U10	IC, LIN, ARRAY, QUAD, PNP, XSTR	477828	12040	DH3467CN	4	1	
U11	IC, LIN, ARRAY, QUAD, PNP, XSTR	477828	12040	DH3467CN	REF		
U12Ø	IC, C-MOS 8-BIT ADDRESSABLE LATCH 16-PIN	453258	02735	CD4099BE	REF		
U13	IC, MATCHED SET	585422	89536	585422	1	1	
U14	(PART OF U13 SET)						
U15	(PART OF U13 SET)						
U19	IC, DISPLAY, LED	478065	50579	DL02614	2	1	
U20	IC, DISPLAY, LED	478065	50579	DL02614	REF		
U21	IC, LIN, NPN XSTR ARRAY 16-PIN DIP	407866	49671	CA3081	2	1	
U22	IC, LIN, NPN XSTR ARRAY 16-PIN DIP	407866	49671	CA3081	REF		
U23	IC, LIN, ARRAY, QUAD, PNP, XSTR	477828	12040	DH3467CN	REF		
U24	IC, LIN, ARRAY, QUAD, PNP, XSTR	477828	12040	DH3467CN	REF		

1 THE DIODES IN THESE SWITCHES CANNOT BE REPLACED. ORDER AS A COMPLETE UNIT. THE SWITCH COMES COMPLETE WITH DIODE AND BUTTON. (DS-5,3,2,4,6,8)

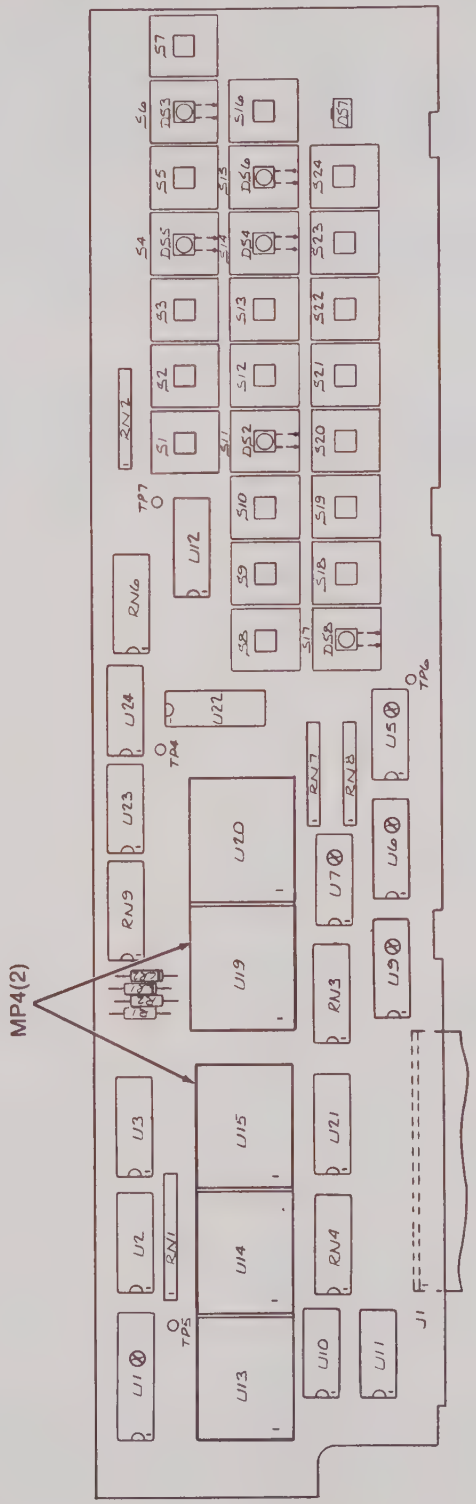


Figure 6-2. A1 Display PCB Assembly

Table 6-3. A2 Digital Controller PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A2	DIGITAL CONTROLLER PCB ASSEMBLY FIGURE 6-3 (8522A-4020T)	608729	89536	608729	REF		
A2A1	PARALLEL/BCD I/O PCB ASSEMBLY	629030	89536	629030	1		
C1	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	6		
C2	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	31		
C3	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C4	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C5	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	REF		
C6-C11	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C12	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	REF		
C13	CAP, MICA, 47 PF +/-5%, 500V	148536	72136	CM15E470J	2		
C14	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	2		
C15	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	1		
C16	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	REF		
C17	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C18	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	REF		
C19	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C20	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C21	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C22	CAP, CER, 1 UF +/-20%, 50V	436782	72982	8131-050-601-105M	REF		
C23	CAP, TA, 39 UF +/-20%, 6V	163915	56289	196D396X0006KA1	1		
C24	CAP, TA, 10 UF +/-20%, 10V	176214	56289	196D106X0010KA1	1		
C25	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	2		
C26	CAP, MICA, 47 PF +/-5%, 500V	148536	72136	CM15E470J	REF		
C27	CAP, TA, 1 UP +/-20%, 35V	161919	56289	196D105X0020JA	2		
C28	CAP, TA, 1 UP +/-20%, 35V	161919	56289	196D105X0020JA	REF		
C29	CAP, TA, 10 UF +/-20%, 20V	193623	56289	196D106X0020KA1	2		
C30	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	2		
C31	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		
C32-C35	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C101	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C102	CAP, MICA, 5 PF +/-5%, 500V	148577	72136	DM15C050K	1		
C103-C109	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C110	CAP, MICA 130 PF +/-5%, 500V	266205	72136	DM15F131J	2		
C111	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C112	CAP, MICA 130 PF +/-5%, 500V	266205	72136	DM15F131J	REF		
C113-C118	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C201	CAP, ELECT, 22000 UF +/-15%, 18V	479220	56289	32DX223G015BA2A	1		
C202	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	1		
C203	CAP, TA, 10 UF +/-20%, 20V	193623	56289	196D106X0020KA1	REF		
C204	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
CR101-CR106	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	6	1	
CR201	DIODE, LIGHT EMITTING	429555	12040	NLS5053	1	1	
CR202	DIODE, SI, RECTIFIER	343491	01295	1N4002	2	1	
CR203	DIODE, SI, RECTIFIER	343491	01295	1N4002	REF		

Table 6-3. A2 Digital Controller PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
H1	P-NUT, 4-40	380196	24347	KF2-440	2		
H2	SCREW, PHP, 4-40 X 5/16	335141	89536	335141	1		
H3	SCREW, PHP, 4-40 X 7/16	403782	89536	403782	1		
H4	SCREW, PHP, 6-32 X 1/4	385401	89536	385401	2		
H5	SCREW, PHP, 10-32 X 5/16	417105	89536	417105	2		
H6	WASHER, SHOULDER	436386	89536	436386	1		
H7	WASHER, SPRING STEEL	571968	89536	571968	2		
J11	CONNECTOR, 20-PIN SIP	443077	00779	583773-9	1		
J12	CONNECTOR, CARD-EDGE, 8-PIN	354951	00779	583407-5	1		
J13	SOCKET, 4-POS SIP	461756	00779	583773-1	1		
J14	HEADER, PROGRAMMED	495507	51167	16-675-191	1		
J15	SOCKET, 16-PIN	276535	91506	316-AG39D	23		
J16	CONNECTOR, 11-PIN	494666	00779	1-640456-1	1		
J201	CONNECTOR, 5-PIN	417899	52072	CA-05S-TSD	1		
L1	CHOKE, 6-TURN	320911	89536	320911	1		
MP1	BRACKET, CAP REG.	490490	89536	490490	1		
MP2	CONNECTING LINK (NOT SHOWN)	523167	89536	523167	1		
MP3	INSULATOR, SEMICONDUCTOR MOUNTING	508630	55285	7403-09-FR-51	1		
MP4	KEY, CONNECTOR POLARIZING (NOT SHOWN)	424572	89536	424572	1		
MP5	SPACER, COMPONENT (NOT SHOWN)	296319	32559	T0806	2		
P30	CONNECTOR	512889	02660	62395	17		
P32	CONNECTOR	512889	02660	62395	REF		
P33	CONNECTOR	512889	02660	62395	REF		
Q1	TRANSISTOR, SI, PNP	195974	04713	2N3906	1	1	
R1	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	7		
R2	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R4	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R5	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R6	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	1		
R7	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	3		
R8	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R9	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	5		
R10	RES, MTL. FILM, 100K +/-1%, 1/8W	248807	91637	CMF551003F	1		
R11	RES, MTL. FILM, 681K +/-1%, 1/8W	381517	91637	CMF556813F	1		
R12	RES, MTL. FILM, 1.5K +/-1%, 1/8W	313098	91637	CMF551501F	1		
R13	RES, MTL. FILM, 10K +/-1%, 1/8W	168260	91637	CMF551002F	1		
R14	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R15	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	1		
R17	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
R18	RES, MTL. FILM, 28.0K +/-1%, 1/8W	291385	91637	CMF552802F	1		
R19	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R20	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R21	RES, MTL. FILM, 82.5K +/-1%, 1/8W	246223	91637	CMF558252F	1		
R23	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R24	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R25	RES, DEP. CAR, 270 +/-5%, 1/4W	348789	80031	CR251-4-5P270E	1		
R26	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R27	RES, DEP. CAR, 750 +/-5%, 1/4W	441659	80031	CR251-4-5P750E	1		
R101	RES, DEP. CAR, 750 +/-5%, 1/4W	441659	80031	CR251-4-5P750E	1		
R102	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		

Table 6-3. A2 Digital Controller PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R103	RES, DEP. CAR, 360 +/-5%, 1/4W	352286	80031	CR251-4-5P360E	1		
R104	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R105	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	2		
R106	RES, MTL. FILM, 69.8 +/-1%, 1/8W	306001	91637	CMF5569R8F	2		
R107	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	REF		
R108	RES, MTL. FILM, 69.8 +/-1%, 1/8W	306001	91637	CMF5569R8F	REF		
R109	RES, DEP. CAR, 5.1 +/-5%, 1/4W	441287	80031	CR251-4-5P5R1	1		
R201	RES, FXD, WW, 1 +/-10%, 2W	485672	89536	485672	1		
R202	RES, MTL. FILM, 249 +/-1%, 1/8W	448043	91637	CMF552490F	1		
R203	RES, MTL. FILM, 649 +/-1%, 1/8W	309955	91637	CMF556490F	1		
R204	RES, VAR, 200 +/-10%, 1/2W	275743	89536	275743	1		
R205	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	1		
R209	RES, COMP, 10K +/-10%, 1/2W	108118	01121	EB1031	1		
R210	RES, WW, 13, 5W	520197	89536	520197	1		
RN1	RESISTOR NETWORK, 10K	414003	89536	414003	6	2	
RN2	RESISTOR NETWORK, 10K	355305	89536	355305	1	1	
RN101-RN105	RESISTOR NETWORK, 10K	414003	89536	414003	REF		
S1	SWITCH	507319	89536	507319	1		
S103	SWITCH, DIP	454769	89536	454769	1		
TP1-TP11	CONNECTOR	512889	02660	62395	REF		
TP101	CONNECTOR	512889	02660	62395	REF		
TP201	CONNECTOR	512889	02660	62395	REF		
TP202	CONNECTOR	512889	02660	62395	REF		
U1Ⓐ	IC, C-MOS, 74C, DUAL "D" F/F	418830	12040	MM74C74	2	1	
U2Ⓐ	IC, TTL, LO-PWR, 3-8 LINE DECODER	407585	01295	SN74LS138N	2	1	
U3Ⓐ	IC, TTL, LO-PWR, 3-8 LINE DECODER	407585	01295	SN74LS138N	REF		
U6	IC, MOS, SI, N-CHANNEL, GATE	472902	34649	P2114L	2	1	
U7	IC, MOS, SI, N-CHANNEL, GATE	472902	34649	P2114L	REF		
U8Ⓐ	IC, TTL LO-PWR SCHTKY OCTAL "D" TYPE F/F	454892	01295	SN74LS273N	1	1	
U9Ⓐ	IC, LO-PWR SCHOTTKY	393124	01295	SN74LS74N	REF		
U10	IC, MOS, ROM	605766	89536	605766	1	1	
U11	IC, MOS, ROM	605774	89536	605774	1	1	
U12	IC, MOS, ROM	605782	89536	605782	1	1	
U13	IC, 32K (4KX8) UV ERASABLE PROM	523605	34649	B2732	1	1	
U16Ⓐ	IC, TTL, QUAD, 2-INPUT, POS NAND GATE	393033	01295	SN74LS00N	2	1	
U17Ⓐ	IC, TTL, POS/NAND, HEX INVERTER	394536	01295	SN74LS05	1	1	
U18	IC, MOS, SI, GATE, N-CHANNEL, 8-BIT	478073	50088	MK3880-4CPU	1	1	
U19	IC, TTL, POS NAND GATES	292979	01295	SN7404N	1	1	
U20	IC, TTL, SYNCHRONOUS COUNTERS	495598	01295	SN74LS163N	1	1	
U21Ⓐ	IC, C-MOS DUAL UP COUNTER	355164	04713	MC14520BCP	2	1	
U22Ⓐ	IC, C-MOS, DUAL TYPE "D" FLIP-FLOP	340117	02735	CD4013AE	1	1	
U23Ⓐ	IC, C-MOS, QUAD, 2-INPUT NAND GATE	404632	02735	CD4093BE	1	1	
U24Ⓐ	IC, TTL, OCT BUS TRNSCVRS W/3-ST OUT	477406	01295	SN74LS245N	2	1	
U25	IC,TTL,MSI,4-16 LINE DECODE/DEMLTIPLXRS	293217	01295	SN74154N	1	1	
U26Ⓐ	IC, C-MOS, RECIEVER, TRANSMITTER	453464	32293	1M6402CPL	1	1	
U27Ⓐ	IC, MOS, TRISTATE HEX BUFFER	407759	12040	MM80C97N	2	1	
U28Ⓐ	IC, C-MOS DUAL UP COUNTER	355164	04713	MC14520BCP	REF		
U29	IC, LINEAR, C-MOS/MOS PLL	403584	02735	CD4046AE	1	1	
U30Ⓐ	IC, TTL, QUAD, 2-INPUT, POS NAND GATE	393033	01295	SN74LS00N	REF		

Table 6-3. A2 Digital Controller PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
U31Ⓧ	IC, MOS, TRISTATE HEX BUFFER	407759	12040	MM80C97N	REF		
U32Ⓧ	IC, C-MOS, PRESET DIV-BY-N-CNTR	478313	02735	CD4018BE	1	1	
U33Ⓧ	IC, TTL, QUAD, 2-INPUT, POS AND GATES	393066	01295	SN74LS08N	1	1	
U34Ⓧ	IC, TTL, POS NAND GATES, HEX INVERTERS	393058	01295	SN74LS04N	1	1	
U35Ⓧ	IC, C-MOS, 74C, DUAL "D" F/F	418830	12040	MM74C74	REF		
U36Ⓧ	IC, LO-POWER SCHOTTKY	404186	01295	SN74LS123N	1	1	
U37	IC, TTL, DUAL PERIPHERAL NAND DRIVE	329706	01295	SN75452P	1	1	
U38	IC, PULSE TRANSFORMER	509141	89536	509141	1	1	
U39Ⓧ	IC, TTL SCHMT/TRIG POSNAND GATE W/TP OUT	504449	01295	SN74L132N	1	1	
U101	IC, MSI, TTL, DECODER/MULTIPLEXER	404152	01295	SN74L154N	1	1	
U102Ⓧ	IC, TTL, OCT BUS TRNSCVRS W/3-ST OUT	477406	01295	SN74LS245N	REF		
U103	IC, TTL, QUAD 2-INPUT NAND GATE	327626	01295	SN7400J	1	1	
U104	IC, TTL, HEX SCHMITT TRIGGER INVERTER	354886	01295	SN7414N	1	1	
U105	IC, OCTAL BUFFERS, LINE DRIVERS	429035	01295	SN74LS244N	1	1	
U106Ⓧ	IC, LO-PWR SCHOTTKY	393124	01295	SN74LS74N	REF		
U107	IC, TRI-STATE HEX BUFFER	483800	01295	SN74LS367N	1	1	
U108	IC, TTL, SCHMT-TRIGG POS NAND GATE	483180	01295	SN74LS14N	REF		
U109	IC, TTL, OCTAL D-TYPE EDGE TRIGGERED F/F	473223	01295	SN74LS374N	REF		
U110	IC, TTL, OCTAL D-TYPE EDGE TRIGGERED F/F	473223	01295	SN74LS374N	REF		
U111-	IC, TTL, 4-BIT D-TYPE REGULATOR	504480	01295	SN74LS173N	8	2	
U118							
U119	IC, TTL, QUAD BUS BUFFERS	473728	12040	DM74125N	1	1	
U120	IC, TTL, OCTAL D-TYPE EDGE TRIGGERED F/F	473223	01295	SN74LS374N	REF		
U121	IC, TTL, QUAD, 2-INPUT, POS AND GATES	292987	01295	SN7408N	1	1	
U122	IC, TTL, SCHMT-TRIGG POS NAND GATE	483180	01295	SN74LS14N	REF		
U123Ⓧ	IC, LO-PWR SCHOTTKY	393124	01295	SN74LS74N	REF		
U124	IC, TTL, QUAD BUFFER GATES	585273	01295	SN74LS126N	1	1	
U125	IC, TTL, QUAD BUS BUFFERS	472746	01295	SN74LS125N	1	1	
U202	IC, LIN, ADJ VOLT REGULATOR	460410	12040	LM317T	1	1	
XRN2	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU1	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	22		
XU2	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU3	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU4-XU7	SOCKET, IC, 18-PIN	418228	91506	318-AG39D	4		
XU8	SOCKET, IC, 20-PIN	454421	01295	C932002	7		
XU9	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU10-XU14	SOCKET, IC, 24-PIN	376236	91506	324-AG39D	7		
XU16	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU17	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU18	SOCKET, IC, 40-PIN	429282	09922	DILB40P-108	2		
XU19	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU20	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU21	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU22	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU23	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU24	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU25	SOCKET, IC, 24-PIN	376236	91506	324-AG39D	REF		
XU26	SOCKET, IC, 40-PIN	429282	09922	DILB40P-108	REF		
XU27	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		

Table 6-3. A2 Digital Controller PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
XU28	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU29	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU30	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU31	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU32	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU33	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU34	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU35	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU36	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU37	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	1		
XU38	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU39	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU96	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU101	SOCKET, IC, 24-PIN	376236	91506	324-AG39D	REF		
XU102	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU103	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU104	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU105	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU106	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU107	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU108	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU109	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU110	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU111-XU118	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU119	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU120	SOCKET, IC, 20-PIN	454421	01295	C932002	REF		
XU121-XU125	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
Y1	CRYSTAL, QUARTZ	485060	89536	485060	1	1	

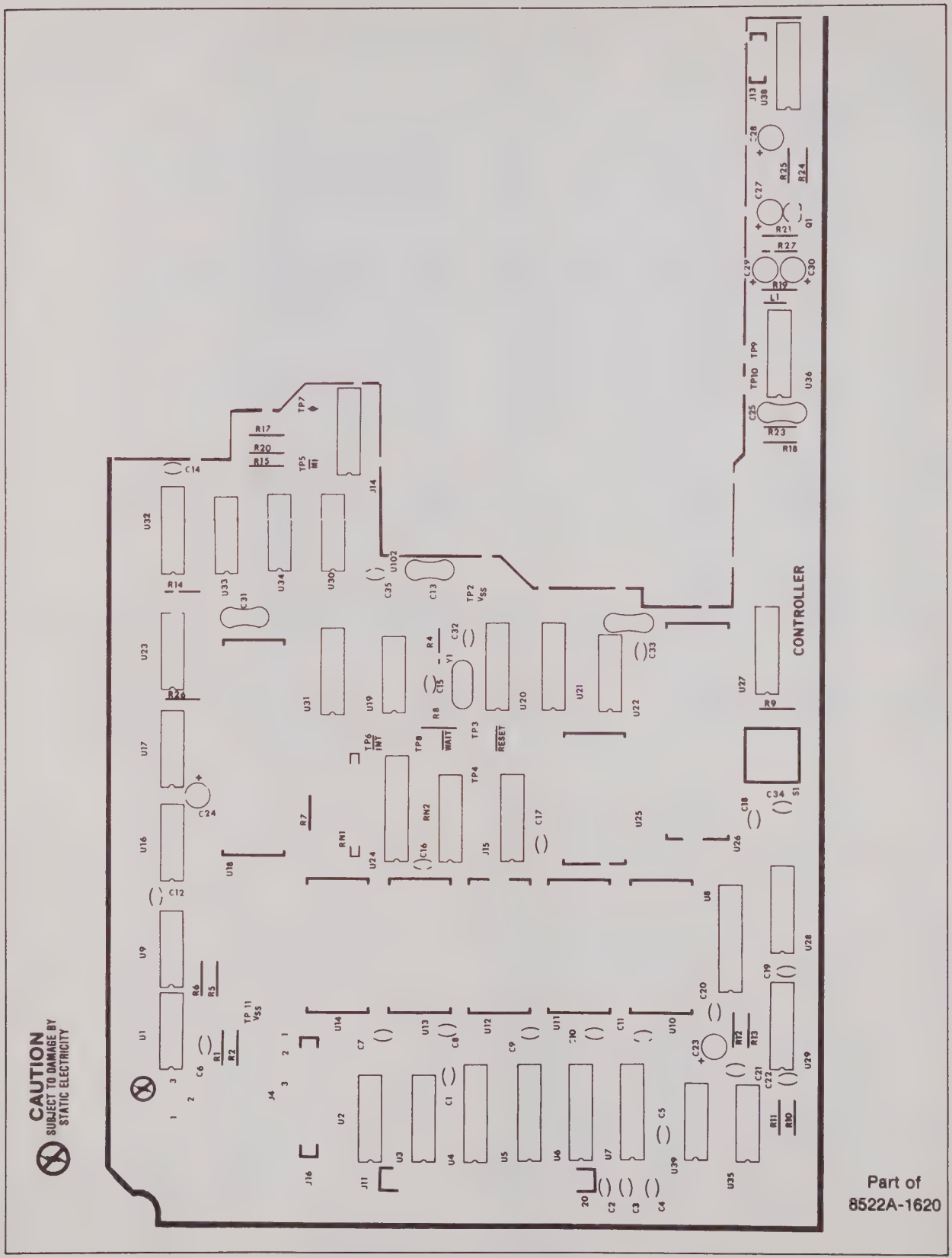


Figure 6-3. A2 Digital Controller PCB Assembly

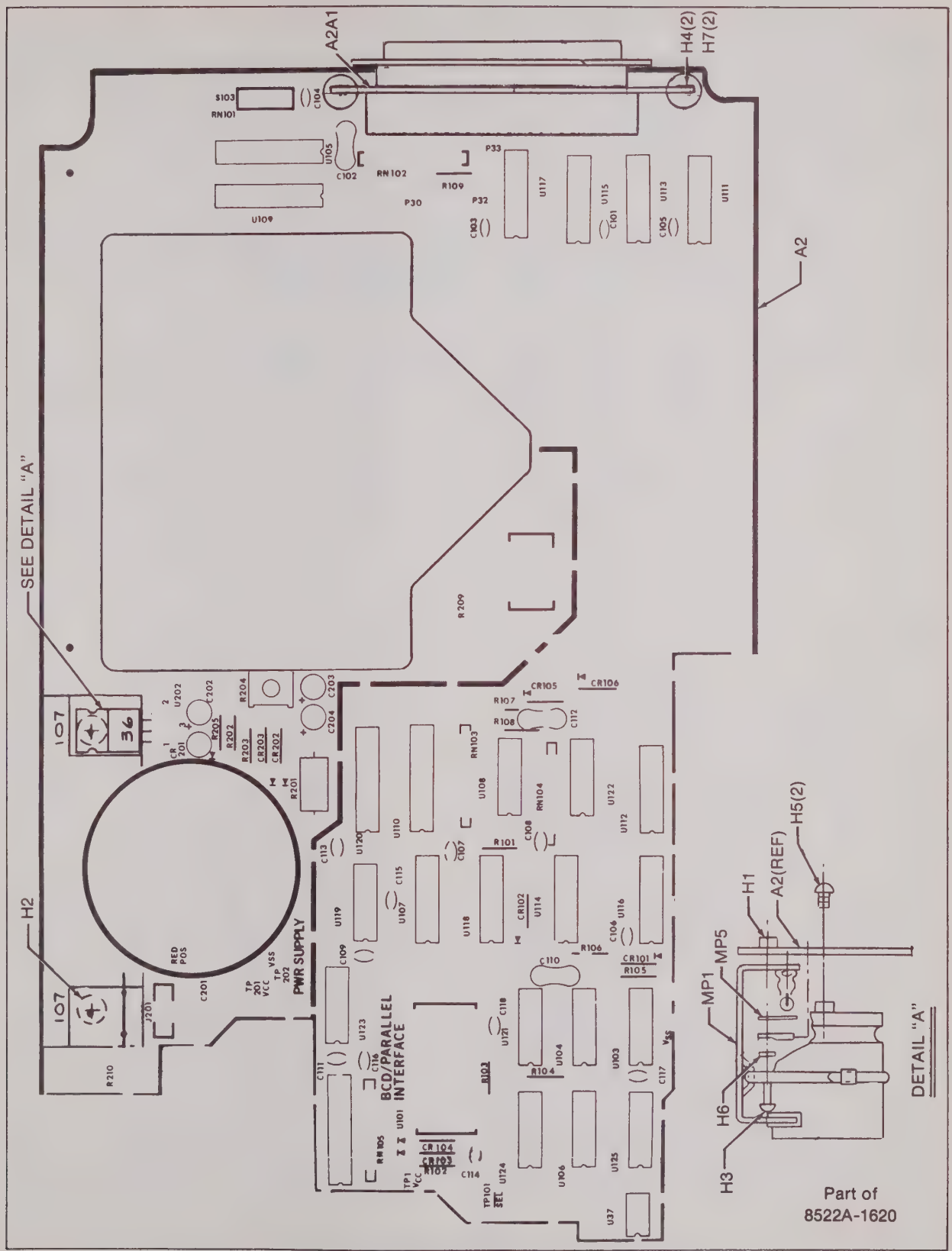


Figure 6-3. A2 Digital Controller PCB Assembly (cont)

Table 6-4. A2A1 Parallel/BCD, I/O PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A2A1	PARALLEL/BCD, I/O PCB ASSEMBLY FIGURE 6-4 (8522A-4009T)	629030	89536	629030	REF		
H1	SCREW, PHP, 6-32 X 1/4	385401	89536	385401	2		
H2	WASHER, SPRING STEEL	571968	89536	571968	2		
J8	CONNECTOR, D-SUB, 37-PIN	615179	28198	MD37F-3000-14	1		
J9	CONNECTOR, D-SUB, 50-PIN	615187	28198	MD50F-3000-14	1		
MP1	SPACER	634063	89536	634063	2		
P32	CONNECTOR, BLADE	512889	02660	62395	1		
W1	CABLE, FLEX, 1.0"	631655	89536	631655	1		
W2	CABLE, FLEX, 1.75"	631663	89536	631663	1		
W3	CABLE, FLEX, 2.0"	631671	89536	631671	1		

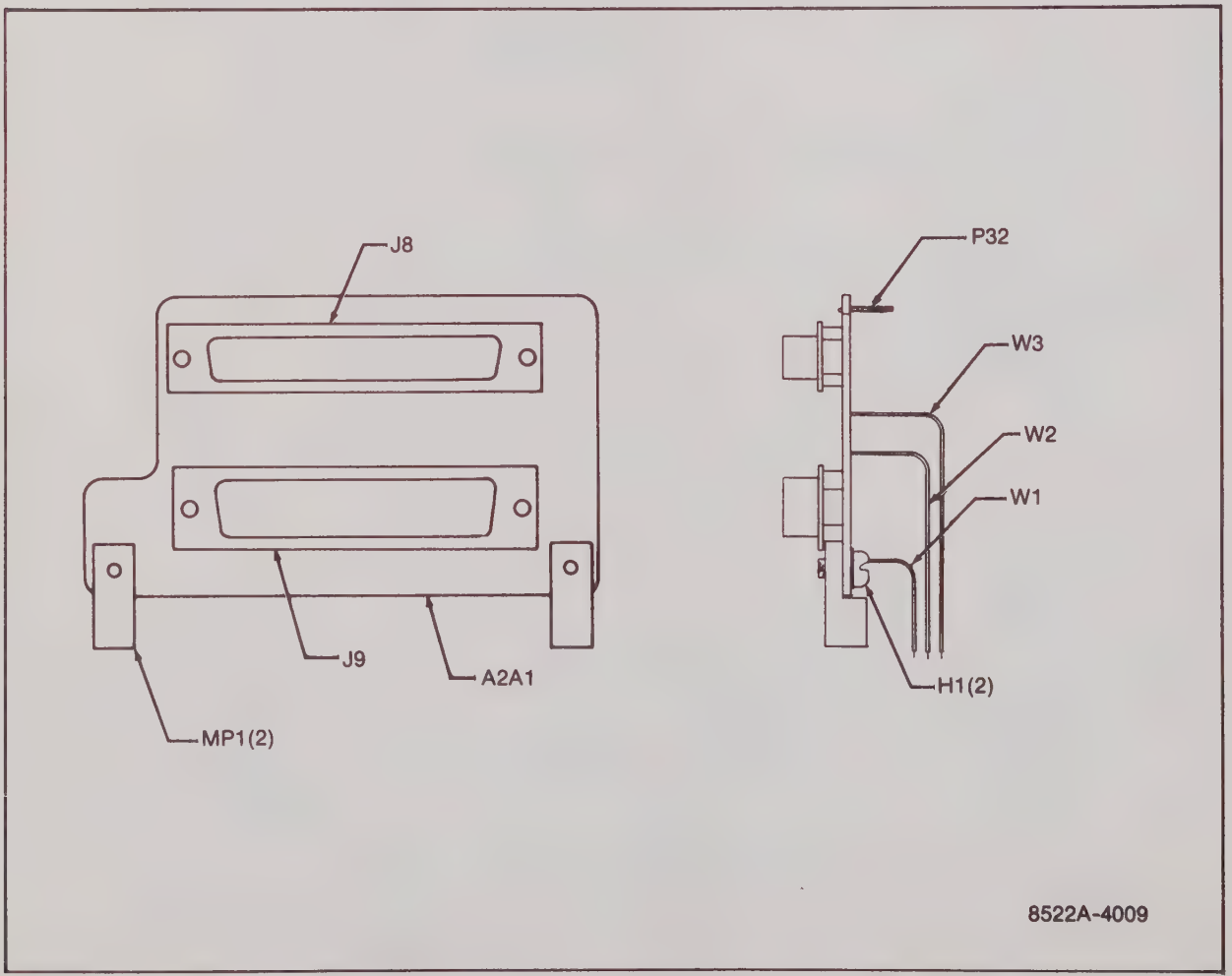


Figure 6-4. A2A1 Parallel/BCD, I/O PCB Assembly

Table 6-5. A3 Analog PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A3Ⓧ	ANALOG PCB ASSEMBLY FIGURE 6-5 (8520A-4030T)	496836	89536	496836	REF		
A3A1	REFERENCE MODULE PCB ASSEMBLY	530626	89536	530626	1		
BR701	RECTIFIER BRIDGE, 1.5AMP	296509	14936	KBP 02	2		
BR702	RECTIFIER BRIDGE, 1.5AMP	296509	14936	KBP 02	REF		
C101	CAP, MICA, 120 PF +/-5%, 500V	148486	72136	DM15F121J	1		
C221	CAP, POLY, 0.0047 UF +/-10%, 200V	512830	89536	512830	1		
C222	CAP, POLY, 0.047 UF +/-10%, 50V	413328	89536	413328	2		
C223	CAP, POLY, 0.047 UF +/-10%, 50V	413328	89536	413328	REF		
C224	CAP, MYLAR, 0.47 UF +/-10%, 50V	271858	06001	75F1R5A474	1		
C225	CAP, VAR, 0.25 - 1.5 PF, 2000V	218206	72982	530.000	4		
C226	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	8		
C227	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	4		
C229	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	REF		
C230	CAP, POLY, 1 UF +/-10%, 50V	271619	84411	X463UW1029,50W	1		
C231	CAP, VAR, 0.25 - 1.5 PF, 2000V	218206	72982	530.000	REF		
C233	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	REF		
C235	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	REF		
C236	CAP, MICA, 47 PF +/-5%, 500V	148536	72136	CM15E470J	1		
C237-C240	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	REF		
C241	CAP, TA, 39 UF +/-20%, 6V	163915	56289	196D396X0006KA1	2		
C243	CAP, CER, 0.0012 UF +/-10%, 500V	106732	71590	CF122	1		
C244	CAP, CER, 150 PF +/-5%, 100V	512988	89536	512988	1		
C301	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	5		
C302	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	5		
C303	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	REF		
C304	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		
C305	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	REF		
C306	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	REF		
C307	CAP, TA, 6.8 UF +/-20%, 35V	363713	56289	196D685X0035KA1	REF		
C308	CAP, TA, 39 UF +/-20%, 6V	163915	56289	196D396X0006KA1	REF		
C310	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	4		
C311	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	REF		
C312	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	REF		
C401	CAP, FILM, 0.22 UF +/-10%, 1000V	485797	52763	MKT-1822322/10	1		
C402	CAP, PORC, 2.2 PF	340273	95275	VY10CA2R2CA	1		
C403	CAP, VAR, 0.25 - 1.5 PF, 2000V	218206	72982	530.000	REF		
C404	CAP, MICA, 15 PF +/-5%, 500V	148569	72136	DM15C150J	2		
C408	CAP, VAR, 0.25 - 1.5 PF, 2000V	218206	72982	530.000	REF		
C409	CAP, CER, 6.8 PF +/-0.1PF, 1500W	485383	56289	561C0CJBA102AE6R8B	1		
C412	CAP, MICA, 390 PF +/-5%, 500V	148437	72136	DM15F391J	1		
C414	CAP, MICA, 62 PF +/-1%	494617	72136	DM15F620F	1		
C415	CAP, MICA, 560 PF +/-1%	494609	72136	DM15F561F	1		
C417	CAP, CER, 4700 PF	362871	72982	8121-A100-W5R-472M	1		
C419	CAP, MICA, 820 PF +/-10%, 500V	226167	72136	DM15F821F	1		
C420	CAP, MICA, 3600 PF +/-10%, 500V	529149	84171	DM15F362F	1		
C422	CAP, CER, 0.047 UF +/-20%, 50V	460733	71590	CW20C473M	1		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
C424-C427	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	12		
C428	CAP, MICA, 2 PF +/-0.5%, 500V	175208	72136	DM15C020E	1		
C429	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	2		
C430	CAP, CER, 0.05 UF -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	REF		
C431	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C432	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C433	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	REF		
C435	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	REF		
C436	CAP, MYLAR, 0.068 UF +/-10%, 100V	485441	89536	485441	2		
C437	CAP, MYLAR, 0.012 UF +/-10%, 50V	402883	80031	75F1R5A123	1		
C438	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C440	CAP, MYLAR, 0.015 UF +/-10%, 50V	402891	80031	75F1R5A153	1		
C441	CAP, MYLAR, 0.068 UF +/-10%, 100V	485441	89536	485441	REF		
C442	CAP, POLY, 0.047 UF +/-10%, 100V	446773	89536	446773	2		
C443	CAP, POLY, 0.047 UF +/-10%, 100V	446773	89536	446773	REF		
C446	CAP, CER, 0.05 UF +/-20%, 50V	175232	56289	C023B101H253M	1		
C447	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C448	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C450-C453	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	4		
C455	CAP, MICA, 51 PF +/-5%, 500V	277210	72136	DM15E510J	1		
C456	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	6		
C501	CAP, MICA, 15 PF +/-5%, 500V	148569	72136	DM15C150J	REF		
C502	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	REF		
C503	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	REF		
C504	CAP, CER, 300 PF +/-10%, 100V	105734	71590	BB60301KW7W	2		
C505	CAP, POLY, 0.022 UF +/-10%, 100V	494948	89536	494948	2		
C506	CAP, POLY, 0.022 UF +/-10%, 100V	494948	89536	494948	REF		
C507	CAP, TA, 4.7 UF +/-20%, 50V	363721	56289	196D475X9015HA1	4		
C508	CAP, TA, 4.7 UF +/-20%, 50V	363721	56289	196D475X9015HA1	REF		
C509	CAP, MYLAR, 0.47 +/-10%, 100V	369124	73445	C280H/A470K	1		
C510	CAP, CER, 300 PF +/-10%, 100V	105734	71590	BB60301KW7W	REF		
C511	CAP, CER, 180 PF +/-10%, 1000V	105890	56289	C023B102E181M	1		
C601	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C602	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		
C603	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		
C604-C607	CAP, TA, 10 UF +/-20%, 10V	176214	56289	196D106X0010KA1	4		
C608	CAP, TA, 10 UF +/-20%, 20V	193623	56289	196D106X0020KA1	2		
C609	CAP, TA, 10 UF +/-20%, 20V	193623	56289	196D106X0020KA1	REF		
C610	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C611	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
C612	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
C614	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
C615	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C616	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
C617	CAP, MICA, 5 PF +/-5%, 500V	148577	72136	DM15C050K	1		
C618	CAP, MICA, 22 PF +/-5%, 500V	148551	02799	DM15C220J	1		
C619	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
C706	CAP, ELECT, 6800 UF -10/+100%, 15V	478784	80031	314AS752V015	1		
C707	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	1		
C708	CAP, TA, 22 UF +/-20%, 15V	423012	56289	196D226X0015KA1	REF		
C709	CAP, ELECT, 470 UF -10/+50%, 50V	478792	89536	478792	2		
C710	CAP, ELECT, 470 UF -10/+50%, 50V	478792	89536	478792	REF		
C711	CAP, ELECT, 330 UF -/+25%, 50V	484436	89536	484436	2		
C712	CAP, ELECT, 330 UF -/+25%, 50V	484436	89536	484436	REF		
C717	CAP, TA, 22 UF +/-20%, 35V	394775	56289	196D226X0035TE4	2		
C718	CAP, TA, 22 UF +/-20%, 35V	394775	56289	196D226X0035TE4	REF		
C719	CAP, TA, 4.7 UF +/-20%, 50V	363721	56289	196D475X9015HA1	REF		
C720	CAP, TA, 4.7 UF +/-20%, 50V	363721	56289	196D475X9015HA1	REF		
CR105	DIODE, ZENER	313221	12969	UZ8716	1	1	
CR107-CR110	DIODE, ZENER	327973	04713	1N967B	4	1	
CR215	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	17	4	
CR218	DIODE, SI, RECTIFIER	180554	07263	FJT1139	6	2	
CR219	DIODE, SI, RECTIFIER	180554	07263	FJT1139	REF		
CR220	DIODE, SI, RECTIFIER	343491	01295	1N4002	3	1	
CR301	DIODE, ZENER	113324	07910	1N961A	1	1	
CR304	DIODE, ZENER	256446	04713	1N755A	1	1	
CR305-CR312	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR313	DIODE, ZENER	387084	07910	1N750	1	1	
CR402	DIODE, LO-CAP, LO-LEAK	375907	07263	FD7222	1	1	
CR404	DIODE, ZENER	260695	04713	1N754A	1	1	
CR405	DIODE, SI, SMALL SIGNAL	313247	28484	HP5082-6264	3	1	
CR406	DIODE, SI, SMALL SIGNAL	313247	28484	HP5082-6264	REF		
CR407-CR410	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR411	DIODE, ZENER	386771	04713	1N756A	1	1	
CR501	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR502	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR503-CR506	DIODE, SI, RECTIFIER	180554	07263	FJT1139	REF		
CR507	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR508	DIODE, SI, SMALL SIGNAL	313247	28484	HP5082-6264	REF		
CR601	DIODE, SI, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
CR703	DIODE, SI	347559	14099	1N5400	4	1	
CR704	DIODE, SI	347559	14099	1N5400	REF		
CR705	DIODE, SI, RECTIFIER	343491	01295	1N4002	REF		
CR706	DIODE, SI, RECTIFIER	343491	01295	1N4002	REF		
CR707	DIODE, SI	347559	14099	1N5400	REF		
CR708	DIODE, LIGHT EMITTING	429555	12040	NLS5053	1	1	
CR709	DIODE, SI	347559	14099	1N5400	REF		
H1	P-NUT, 4-40	380196	24347	KF2-440	2		
H2	SCREW, PHP, 4-40 X 1/4	256156	89536	256156	2		
H3	SCREW, PHP, 4-40 X 5/16	152116	89536	152116	5		
H4	WASHER, SHOULDER	436386	86928	5607-45	5		
J19-J22	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	15		
J418	SOCKET, 4-PIN	417311	30035	SS-109-1-04	4		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
J419	SOCKET, 4-PIN	417311	30035	SS-109-1-04	REF		
J420	SOCKET, 4-PIN	417311	30035	SS-109-1-04	REF		
J502	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	12		
K101	RELAY, PHONE TYPE, DPDT	519710	89536	519710	1		
K102	RELAY, PHONE TYPE, 2 POLE	357707	26806	AZ-420-12-202	1		
K103	RELAY, PHONE TYPE, 4 POLE	422931	77342	RIO-E3713-3	1		
K104	RELAY, DRY REED	500132	89536	500132	3		
K301	RELAY, DRY REED	357582	71707	UF40070	3		
K302	RELAY, DRY REED	357582	71707	UF40070	REF		
K303	RELAY, DRY REED	357582	71707	UF40070	REF		
K304	RELAY, DRY REED	500132	89536	500132	REF		
K401	RELAY, DRY REED	500132	89536	500132	REF		
L201	CHOKE, CORE	321182	89536	321182	2		
L202	CHOKE, CORE	321182	89536	321182	REF		
MP1	BALL STUD	347542	89536	347542	6		
MP2	BRACKET, ANA HEATSINK	490995	89536	490995	1		
MP3	CONNECTING LINK (TO J418, J419, J420)	523159	89536	523159	3		
MP4	FEED-THRU, TEFLON, 4-LEAD (NOT SHOWN)	281865	12615	SL-841-777	2		
MP5	GUIDE, PIN (NOT SHOWN)	535971	89536	535971	2		
MP6	HEADER, PROGRAMMED (NOT SHOWN)	504373	51167	14-675-191	4		
MP7	HEADER, PROGRAMMED (NOT SHOWN)	495507	51167	16-675-191	1		
MP8	HEATSINK (NOT SHOWN)	347740	05820	260-18D	1		
MP9	INSULATOR, SEMI-CONDUCTOR MOUNTING	508630	55285	7403-09-FR-51	5		
MP10	PINS, CONTACT	376574	00779	3-87022-1	3		
MP11	SOCKET, COMPONENT LEAD (NOT SHOWN)	343285	00779	2-331272-6	2		
MP12	SOCKET, COMPONENET LEAD (NOT SHOWN)	376418	22526	75060-005	12		
MP13	SPACER, COMPONENT (NOT SHOWN)	296319	32559	T0806	2		
MP14	SHIELD, AC CONVERTER (NOT SHOWN)	574984	89536	574984	1		
MP15	SHIELD, DC BUFFER (NOT SHOWN)	496786	89536	496786	1		
P13	SOCKET, 4-PIN	417311	30035	SS-109-1-04	REF		
P17	CONNECTOR, 11-PIN	494666	00779	1-640456-1	1		
P23	CONNECTOR, PIN	233411	00779	60599-3	2		
Q103	TRANSISTOR, J-FET, N-CHANNEL (SELECT)	483099	89536	483099	5	1	
Q104	TRANSISTOR, J-FET, N-CHAN, HI-VOLT	524157	32293	ITS31250	3	1	
Q106	TRANSISTOR, J-FET, N-CHANNEL (SELECT)	483099	89536	483099	REF		
Q107	TRANSISTOR, J-FET, N-CHANNEL (SELECT)	483099	89536	483099	REF		
Q108	TRANSISTOR, J-FET, N-CHANNEL (SELECT)	483099	89536	483099	REF		
Q111-Q114	TRANSISTOR, FET, N-CHANNEL	393314	89536	393314	7	2	
Q115	TRANSISTOR, SI, NPN	168716	07263	S19254	4	1	
Q116	TRANSISTOR, SI, NPN	168716	07263	S19254	REF		
Q221	TRANSISTOR, J-FET, N-CHAN, HI-VOLT	524157	32293	ITS31250	REF		
Q223	TRANSISTOR, J-FET, N-CHAN, HI-VOLT	524157	32293	ITS31250	REF		
Q224	TRANSISTOR, J-FET, N-CHANNEL (SELECT)	483099	89536	483099	REF		
Q225	TRANSISTOR, PNP, HI-SPEED SWITCHING	369629	07263	543576	2	1	
Q226	TRANSISTOR, PNP, HI-SPEED SWITCHING	369629	07263	543576	REF		
Q227	TRANSISTOR, DUAL, N-CHAN, J-FET, MONO	478172	32293	IT502P	2	1	
Q228	TRANSISTOR, SI, NPN	218396	89536	218396	5	1	
Q229	TRANSISTOR, SI, NPN	218396	89536	218396	REF		
Q230	TRANSISTOR, SI, NPN	218396	89536	218396	REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
Q231⊗	TRANSISTOR, FET, D-MOS, N-CHAN	394122	18324	SD210	3	1	
Q232⊗	TRANSISTOR, FET, D-MOS, N-CHAN	394122	18324	SD210	REF		
Q233⊗	TRANSISTOR, FET, D-MOS, N-CHAN	394122	18324	SD210	REF		
Q234	TRANSISTOR, DUAL, N-CHAN, J-FET, MONO	478172	32293	IT502P	REF		
Q235	TRANSISTOR, SI, NPN	218396	89536	218396	REF		
Q236	TRANSISTOR, FET, N-CHANNEL	393314	89536	393314	REF		
Q237	TRANSISTOR, FET, N-CHANNEL	393314	89536	393314	REF		
Q238	TRANSISTOR, FET, N-CHANNEL	393314	89536	393314	REF		
Q239	TRANSISTOR, SI, PNP	266619	07263	2N4888	2	1	
Q240	TRANSISTOR, SI, PNP	266619	07263	2N4888	REF		
Q304	TRANSISTOR, SI, NPN	218396	89536	218396	REF		
Q305	TRANSISTOR, J-FET, N-CHANNEL	508697	21845	FS933	11	3	
Q306	TRANSISTOR, J-FET, N-CHANNEL	508697	21845	FS933	REF		
Q308	TRANSISTOR, FET, N-CHANNEL	343830	89536	343830	1	1	
Q309	TRANSISTOR, DUAL, NPN	478099	12040	LM3940M	1	1	
Q310	TRANSISTOR, SI, NPN	168716	07263	S19254	REF		
Q311	TRANSISTOR, SI, NPN	168716	07263	S19254	REF		
Q314	TRANSISTOR, SI, NPN	203489	09214	11C2322	2	1	
Q315	TRANSISTOR, SI, NPN	203489	09214	11C2322	REF		
Q316	TRANSISTOR, J-FET, (MATCHED SET OF 3)	274795	89536	274795	2	1	
Q317	TRANSISTOR, SMALL SIGNAL	524140	04713	MPS-A63	1	1	
Q401	TRANSISTOR, J-FET, N-CHANNEL	288324	89536	288324	5	1	
Q402	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	18	4	
Q403-Q406	TRANSISTOR, J-FET, N-CHANNEL	288324	89536	288324	REF		
Q407	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q408	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q409	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q410	TRANSISTOR, SI, PNP	229898	04713	MPS6522	1	1	
Q411	TRANSISTOR, SI, NPN	218081	04713	MPS6520	1	1	
Q414	TRANSISTOR, MATCHED PAIR	504191	89536	504191	1	1	
Q415	TRANSISTOR, MATCHED PAIR	504191	89536	504191	REF		
Q416-Q419	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q421	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q501	TRANSISTOR, J-FET, (MATCHED SET OF 3)	274795	89536	274795	REF		
Q502	(PART OF Q501 SET)				REF		
Q503	(PART OF Q501 SET)				REF		
Q504	TRANSISTOR, MATCHED SET	504209	89536	504209	1	1	
Q505	TRANSISTOR, MATCHED SET	504209	89536	504209	REF		
Q506-Q509	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q510	(PART OF Q316 SET)				REF		
Q511	(PART OF Q316 SET)				REF		
Q512	TRANSISTOR, FET, N-CHANNEL (GROUP OF 10)	492306	89536	492306	1	1	
Q513	(PART OF Q512 GROUP)				REF		
Q514	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q515	(PART OF Q512 GROUP)				REF		
Q516	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q517	(PART OF Q512 GROUP)				REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
Q518	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q519	(PART OF Q512 GROUP)				REF		
Q520	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q521	(PART OF Q512 GROUP)				REF		
Q522	TRANSISTOR, FET, N-CHANNEL	261578	89536	261578	REF		
Q523-Q526	(PART OF Q512 GROUP)				REF		
Q527	TRANSISTOR, SI, PNP	195974	04713	2N3906	1	1	
Q528-Q532	TRANSISTOR, J-FET, N-CHANNEL	508697	21845	FS933	REF		
R101	THERMISTOR, 500	500017	89536	500017	2		
R102	THERMISTOR, 500	500017	89536	500017	REF		
R103	THERMISTER, 1K +/-40%	494740	50157	180Q10215	1		
R104	RES, MTL. FILM, 2K +/-1%, 7W	500033	89536	500033	1		
R109	RES, VAR, 200 +/-10%, 1/2W	275743	89536	275743	1		
R110	RES, COMP, 150K +/-5%, 2W	110122	01121	HB1545	1		
R111	RES, DEP. CAR, 220K +/-5%, 1/4W	348953	80031	CR251-4-5P220K	1		
R112	RES, DEP. CAR, 150K +/-5%, 1/4W	348938	80031	CR251-4-5P150K	1		
R113	RES, COMP, 1M +/-10%, 1/2W	108134	01121	EB1051	1		
R114	RES, MTL. FILM, 150K +/-1%, 1/8W	241083	91637	CMF551503F	2		
R115	RES, MTL. FILM, 150K +/-1%, 1/8W	241083	91637	CMF551503F	REF		
R120	RES, DEP. CAR, 8.2K +/-5%, 1/4W	441675	80031	CR251-4-5P8K2	2		
R121	RES, DEP. CAR, 8.2K +/-5%, 1/4W	441675	80031	CR251-4-5P8K2	REF		
R223	RES, MTL. FILM, 71.5K +/-1%, 1/8W	291435	91637	CMF557152F	3		
R224	RES, MTL. FILM, 169K +/-1%, 1/8W	289454	91637	CMF551693F	1		
R225	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	4		
R226	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	REF		
R227	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	8		
R228	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R229	RES, MTL. FILM, 93.1K +/-1%, 1/8W	223586	91637	CMF559312F	1		
R230	RES, MTL. FILM, 14.7K +/-1%, 1/8W	226225	91637	CMF551472F	1		
R231	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R232	RES, MTL. FILM, 1.21K +/-1%, 1/8W	229146	91637	CMF551211F	2		
R234	RES, MTL. FILM, 1.87K +/-1%, 1/8W	267229	91637	CMF551871F	1		
R235	RES, MTL. FILM, 1.47K +/-1%, 1/8W	293654	91637	CMF551471F	1		
R236	RES, VAR, 5K +/-10%, 1/2W	327569	11236	360T-502A	1		
R237	RES, MTL. FILM, 1.21K +/-1%, 1/8W	229146	91637	CMF551211F	REF		
R239	RES, MTL. FILM, 1.3K +/-1%, 1/8W	343921	91637	CMF551301F	2		
R240	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	REF		
R241	RES, MTL. FILM, 1K +/-1%, 1/8W	168229	91637	CMF551001F	REF		
R242	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	3		
R243	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R244	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R247	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R251	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	6		
R252	RES, MTL. FILM, 71.5K +/-1%, 1/8W	291435	91637	CMF557152F	REF		
R253	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	REF		
R254	RES, MTL. FILM, 71.5K +/-1%, 1/8W	291435	91637	CMF557152F	REF		
R255	RES, DEP. CAR, 15 +/-5%, 1/4W	348755	80031	CR251-4-5P15E	2		
R256	RES, DEP. CAR, 15 +/-5%, 1/4W	348755	80031	CR251-4-5P15E	REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R257	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	5		
R258	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R261	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	8		
R264	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R265	RES, COMP, 4.7K +/-5%, 1/4W	348821	01121	CB4725	2		
R266	RES, COMP, 4.7K +/-5%, 1/4W	348821	01121	CB4725	REF		
R267	RES, MTL. FILM, 2.74K +/-1%, 1/8W	293761	91637	CMF552741F	2		
R268	RES, MTL. FILM, 12.7K +/-1%, 1/8W	294918	91637	CMF551272F	1		
R269	RES, MTL. FILM, 2.74K +/-1%, 1/8W	293761	91637	CMF552741F	REF		
R270	RES, MTL. FILM, 51.1K +/-1%, 1/8W	289553	91637	CMF555112F	2		
R271	RES, MTL. FILM, 12.7K +/-1%, 1/8W	217448	91637	CMF551272F	1		
R272	THERMISTOR, TEMP SENSITIVE	104596	73168	JA41J1	1		
R273	RES, COMP, 470M +/-10%, 1/4W	603550	01121	CB477	1		
R280	RES, COMP, 10 +/-10%, 1/8W	321125	01121	BB1001	1		
R303	REFERENCE RESISTOR, 24.982K	503821	89536	503821	1		
R305	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	5		
R306	RES, MTL. FILM, 76.8K +/-1%, 1/8W	257394	91637	CMF557682F	1		
R307	RES, MTL. FILM, 57.6K +/-1%, 1/8W	484915	91637	CMF555762F	1		
R308	RES, MTL. FILM, 25.5K +/-1%, 1/8W	446666	91637	CMF552552F	1		
R309	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	2		
R311	RES, VAR, 500 +/-10%, 1/2W	325613	89536	325613	3		
R312	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R314	RES, VAR, 50 +/-10%, 1/2W	447862	11236	360T-500A	4		
R315	RES, VAR, 1K +/-10%, 1/2W	275750	11236	360T-102A	2		
R317	RES, VAR, 50K +/-10%, 1/2W	335778	11236	360T-503A	1		
R318	RES, MTL. FILM, 191K +/-1%, 1/8W	375923	91637	CMF551913F	1		
R319	RES, VAR, 10K +/-10%, 1/2W	485458	32997	3299W-CR2-103	3		
R320	RES, FILM, 4.0455M +/-0.1%, 300V	474932	89536	474932	1		
R321	RES, FILM, 449.55K +/-0.1%, 1/3W, 300V	478990	89536	478990	1		
R322	RES, MTL. FILM, 13.7K +/-1%, 1/8W	236752	91637	CMF551372F	1		
R323	RES, MTL. FILM, 2K +/-1%, 1/8W	235226	91637	CMF552001F	1		
R324	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R325	RES, VAR, 25K +/-10%, 1/2W	500769	32997	3299W-W-253	1		
R326	RES, MTL. FILM, 20K +/-1%, 1/8W	291872	91637	CMF552002F	REF		
R327	RESISTOR SET MATCHED (R327/R328)	290320	89536	290320	1		
R328	RESISTOR SET MATCHED (R327/R328)	290320	89536	290320	REF		
R329	RES, MTL. FILM, 12.1K +/-1%, 1/8W	234997	91637	CMF551212F	1		
R330	RES, MTL. FILM, 3.16M +/-1%, 1/8W	494815	91637	CMF553164F	1		
R331	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R332	RES, MTL. FILM, 10K +/-5%, 6W	500025	89536	500025	1		
R334	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R335	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R336	RES, DEP. CAR, 150 +/-5%, 1/4W	343442	80031	CR251-4-5P150E	REF		
R341	RES, MTL. FILM, 37.4K +/-1%, 1/8W	226241	91637	CMF553742F	1		
R342	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	REF		
R343	RES, DEP. CAR, 330K +/-5%, 1/4W	376640	80031	CR251-4-5P330K	1		
R401	RES, COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	1		
R403	RES, MTL. FILM, 1.1104M +/-0.05%, 3/4W	493627	19647	TF050R	1		
R408	RES, VAR, 10K +/-10%, 1/2W	485458	32997	3299W-CR2-103	REF		
R412	RES, MTL. FILM, 556.39K +/-0.1%, 1/8W	485367	89536	485367	1		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R421	RES, MTL. FILM, 79.240K +/-0.1%, 1/8W	485334	89536	485334	1		
R422	RES, VAR, 500 +/-10%, 1/2W	325613	89536	325613	REF		
R425	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	REF		
R426	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	REF		
R427	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	4		
R428	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	REF		
R432	RES, MTL. FILM, 8.8091K +/-0.1%, 1/8W	485342	89536	485342	1		
R433	RES, VAR, 50 +/-10%, 1/2W	447862	11236	360T-500A	REF		
R435	RES, DEP. CAR, 62K +/-5%, 1/4W	348904	80031	CR251-4-5P62K	1		
R436	RES, MTL. FILM, 1.1108K +/-0.1%, 1/8W	485359	91637	485359	1		
R437	RES, MTL. FILM, 47.5K +/-1%, 1/8W	289546	91637	CMF554752	1		
R438	RES, VAR, 20K +/-10%, 1/2W	335760	11236	360T-203A	1		
R439	RES, DEP. CAR, 51K +/-5%, 1/4W	376434	80031	CR251-4-5P51K	1		
R440	RES, VAR, 50 +/-10%, 1/2W	500009	32997	3299W-CR2-500	1		
R441	RES, MTL. FILM, 4.975K +/-0.1%, 1/8W	340232	89536	340232	1		
R442	RES, MTL. FILM, 169 +/-1%, 1/8W	236869	91637	CMF551690F	1		
R443	RES, MTL. FILM, 1M +/-1%, 1/8W	268797	91637	CMF551004F	3		
R444	RES, DEP. CAR, 1.5K +/-5%, 1/4W	343418	80031	CR251-4-5P1K5	2		
R445	RES, VAR, 200K +/-10%, 1/2W	381921	32997	3299W-CR2-204	2		
R446	RES, DEP. CAR, 2.4K +/-5%, 1/4W	441493	80031	CR251-4-5P2K4	2		
R447	RES, DEP. CAR, 2.4K +/-5%, 1/4W	441493	80031	CR251-4-5P2K4	REF		
R448	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	4		
R449	RES, DEP. CAR, 3K +/-5%, 1/4W	441527	80031	CR251-4-5P3K	2		
R450	RES, DEP. CAR, 9.1K +/-5%, 1/4W	441691	80031	CR251-4-5P9K1	1		
R451	RES, DEP. CAR, 3K +/-5%, 1/4W	441527	80031	CR251-4-5P3K	REF		
R452	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
R453	RES, MTL. FILM, 4.99K +/-1%, 1/8W	168252	91637	CMF554991F	1		
R454	RES, DEP. CAR, 750 +/-5%, 1/4W	441659	80031	CR251-4-5P750E	2		
R455	RES, MTL. FILM, 5K +/-0.1%, 1/8W	340240	89536	340240	1		
R456	RES, DEP. CAR, 560 +/-5%, 1/4W	385948	80031	CR251-4-5P560E	1		
R457	RES, MTL. FILM, 10K +/-0.1%, 1/8W	435065	89536	435065	1		
R458	RES, MTL. FILM, 20K +/-0.1%, 1/8W	340620	89536	340620	1		
R459	RES, DEP. CAR, 240K +/-5%, 1/4W	442459	80031	CR251-4-5P240K	1		
R461	RES, MTL. FILM, 1M +/-1%, 1/8W	268797	91637	CMF551004F	REF		
R462	RES, MTL. FILM, 1.3K +/-1%, 1/8W	343921	91637	CMF551301F	REF		
R463	RES, VAR, 200K +/-10%, 1/2W	381921	32997	3299W-CR2-204	REF		
R464	RES, DEP. CAR, 750 +/-5%, 1/4W	441659	80031	CR251-4-5P750E	REF		
R466	RES, COMP, 5.1 +/-5%, 1/4W	281832	01121	CB5R15	1		
R467	RES, DEP. CAR, 300K +/-5%, 1/4W	441535	80031	CR251-4-5P300K	3		
R468	RES, DEP. CAR, 6.8K +/-5%, 1/4W	368761	80031	CR251-4-5P6K8	1		
R470	RES, MTL. FILM, 316K +/-1%, 1/8W	289496	91637	CMF553163F	1		
R472	RES, DEP. CAR, 47K +/-5%, 1/4W	348896	80031	CR251-4-5P47K	2		
R473	RES, DEP. CAR, 47K +/-5%, 1/4W	348896	80031	CR251-4-5P47K	REF		
R474	RES, DEP. CAR, 43K +/-5%, 1/4W	442418	80031	CR251-4-5P43K	2		
R475	RES, DEP. CAR, 300K +/-5%, 1/4W	441535	80031	CR251-4-5P300K	REF		
R476	RES, DEP. CAR, 300K +/-5%, 1/4W	441535	80031	CR251-4-5P300K	REF		
R477	RES, DEP. CAR, 43K +/-5%, 1/4W	442418	80031	CR251-4-5P43K	REF		
R478	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	REF		
R479	RES, DEP. CAR, 82 +/-5%, 1/4W	442277	80031	CR251-4-5P82E	1		
R480	RES, MTL. FILM, 315.0K +/-0.1%, 1/8W	485375	89536	485375	2		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R481	RES, VAR, 10K +/-10%, 1/2W	485458	32997	3299W-CR2-103	REF		
R482	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
R483	RES, MTL. FILM, 315.0K +/-0.1%, 1/8W	485375	89536	485375	REF		
R488	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	REF		
R489	RES, DEP. CAR, 5.6 +/-5%, 1/4W	441618	80031	CR251-4-5P5R6	1		
R501	RES, MTL. FILM, 6.49K +/-1%, 1/8W	294900	91637	CMF556491F	2		
R502	RES, MTL. FILM, 100 +/-1%, 1/8W	168195	91637	CMF551000F	1		
R503	RES, VAR, 5K +/-10%, 200V	493593	32997	3299W-CR2-502	2		
R504	RES, VAR, 5K +/-10%, 200V	493593	32997	3299W-CR2-502	REF		
R505	RES, MTL. FILM, 51.1K +/-1%, 1/8W	289553	91637	CMF555112F	REF		
R506	RES, DEP. CAR, 27K +/-5%, 1/4W	441501	80031	CR251-4-5P27K	2		
R507	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	2		
R508	RES, MTL. FILM, 6.49K +/-1%, 1/8W	294900	91637	CMF556491F	REF		
R510	RES, DEP. CAR, 27K +/-5%, 1/4W	441501	80031	CR251-4-5P27K	REF		
R511	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	REF		
R512	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R513	RES, VAR, 100K +/-10%, 1/2W	369520	11236	360T-104A	1		
R514	RES, MTL. FILM, 1M +/-1%, 1/8W	268797	91637	CMF551004F	REF		
R515	RES, MTL. FILM, 133K +/-1%, 1/8W	289074	91637	CMF551333F	1		
R516	RES, MTL. FILM, 143 +/-1%, 1/8W	192906	91637	CMF551430F	1		
R517	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R518	RES, VAR, 1K +/-10%, 1/2W	275750	11236	360T-102A	REF		
R519	RES, VAR, 500 +/-10%, 1/2W	325613	89536	325613	REF		
R520	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	REF		
R521	RES, VAR, 50 +/-10%, 1/2W	447862	11236	360T-500A	REF		
R522	RES, VAR, 20 +/-20%, 1/2W	275727	11236	360T-200B	1		
R523	RES, MTL. FILM, 26.7K +/-1%, 1/8W	245779	91637	CMF552672F	2		
R524	RES, MTL. FILM, 28.7K +/-1%, 1/8W	235176	91637	CMF552872F	1		
R525	RES, MTL. FILM, 33.2K +/-1%, 1/8W	291393	91637	CMF553322F	1		
R526	RES, MTL. FILM, 44.9K +/-1%, 1/8W	268821	91637	CMF554992F	1		
R527	RES, VAR, 100 +/-10%, 1/2W	275735	89536	275735	REF		
R528	RES, DEP. CAR, 1.5K +/-5%, 1/4W	343418	80031	CR251-4-5P1K5	REF		
R529	RES, DEP. CAR, 510 +/-5%, 1/4W	441600	80031	CR251-4-5P510E	REF		
R530	RES, DEP. CAR, 15K +/-5%, 1/4W	348854	80031	CR251-4-5P15K	1		
R532	RES, MTL. FILM, 26.7K +/-1%, 1/8W	245779	91637	CMF552672F	REF		
R534	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	2		
R535	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	REF		
R538	RES, MTL. FILM, 130 +/-1%, 1/8W	485698	91637	CMF551300F	1		
R539	RES, MTL. FILM, 200 +/-1%, 1/8W	245340	91637	CMF552000F	1		
R601	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R602	RES, MTL. FILM, 82.5K +/-1%, 1/8W	246223	91637	CMF558252F	1		
R603	RES, MTL. FILM, 28.0K +/-1%, 1/8W	291385	91637	CMF552802F	1		
R604	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	1		
R606	RES, COMP, 100K +/-5%, 1/4W	348920	01121	CB1045	1		
R609	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
R612	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R613	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R614	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
R619	RES, DEP. CAR, 820 +/-5%, 1/4W	442327	80031	CR251-4-5P821E	1		
R621	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R622	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R623	RES, DEP. CAR, 1.2K +/-5%, 1/4W	441378	80031	CR251-4-5P1K2	1		
R709	RES, WW, 0.1 +/-10%, 2W	485672	89536	485672	1		
R710	RES, VAR, 50 +/-10%, 1/2W	447862	11236	360T-500A	REF		
R711	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	REF		
R712	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	REF		
R713	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	2		
R714	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	REF		
RN101	RESISTOR NETWORK	485128	89536	485128	1	1	
RN104	RESISTOR NETWORK ASSEMBLY	502955	89536	502955	1	1	
RN202	RESISTOR NETWORK	516930	89536	516930	2	1	
RN203	RESISTOR NETWORK ASSEMBLY	502922	89536	502922	1	1	
RN301	RESISTOR NETWORK	516930	89536	516930	REF		
RN302	RESISTOR NETWORK ASSEMBLY	502971	89536	502971	1	1	
RN401	RESISTOR NETWORK	520122	89536	520122	1	1	
RN402	RESISTOR NETWORK	412916	89536	412916	1	1	
RN501	RESISTOR NETWORK ASSEMBLY	502948	89536	502948	1	1	
RN502	RESISTOR NETWORK ASSEMBLY	502963	89536	502963	1	1	
RN503	RESISTOR NETWORK	412726	89536	412726	1	1	
RN504	RESISTOR NETWORK	412908	89536	412908	1	1	
RN505	RESISTOR NETWORK	380618	89536	380618	1	1	
RN601	RESISTOR NETWORK	414003	89536	414003	1	1	
RN602	RESISTOR NETWORK	412924	89536	412924	2	1	
RN603	RESISTOR NETWORK	412924	89536	412924	REF		
RV101	VARISTOR, 390V	423475	09214	V390MAX781	2	1	
RV102	VARISTOR, 390V	423475	09214	V390MAX781	REF		
RV103	VARISTOR, 330V	520874	09214	V330MA5B	3	1	
RV104	VARISTOR, 330V	520874	09214	V330MA5B	REF		
RV105	VARISTOR, 330V	520874	09214	V330MA5B	REF		
RV701	VARISTOR, 33V	485391	89536	485391	1	1	
S101	SWITCH, PUSHBUTTON	504852	89536	504852	1	1	
S102	SWITCH, PUSHBUTTON	504845	89536	504845	1	1	
TP	CONNECTOR, TEST POINT (TYPICAL)	512889	00779	62395-1	42		
U101	TRANSISTOR ARRAY, HI-VOLT, HI-CURRENT	483081	01295	ULN2004AN	1	1	
U102	IC, HIGH VOLTAGE DISPLAY DRIVERS	504795	56289	UPH-480	2	1	
U103⊗	IC, C-MOS, HEX OPEN DRAIN P-CHAN BUFFERS	418947	12040	MM74C907N	2	1	
U205	IC, LINEAR, OP-AMP	472779	12040	LF386N	1	1	
U206⊗	IC, C-MOS, HEX OPEN DRAIN P-CHAN BUFFERS	418947	12040	MM74C907N	REF		
U207⊗	IC, C-MOS, HEX INVERTER	404699	12040	MM74C04N	3	1	
U208⊗	IC, TTL, POS NAND GATES AND INVERTERS	394205	01295	SN74LS03N	1	1	
U209	IC, HIGH VOLTAGE DISPLAY DRIVERS	504795	56289	UPH-480	REF		
U210	IC, LINEAR, OP-AMP	392902	12040	LM1436H	2	1	
U211	IC, LINEAR, OP-AMP	392902	12040	LM1436H	REF		
U301	IC, LINEAR ARRAY, 2-PNP, 16-PIN DIP	418954	02735	CA3096E	1	1	
U302	IC, LINEAR, OP-AMP	478107	12040	308AN	2	1	
U303	IC, LINEAR, OP-AMP	478107	12040	308AN	REF		
U401	IC, LINEAR OP-AMP	495101	89536	495101	1	1	
U402	IC, LINEAR OP-AMP, J-FET INPUT	477869	12040	LF357H	1	1	
U403	IC, LIN, OP-AMP, MONOLITHIC, J-FET INPUT	429837	12040	LF356F	1	1	
U404	IC, LINEAR, J-FET	495119	12040	LF353BN	1	1	

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
U405	IC, LINEAR OP-AMP, J-FET INPUT	483305	12040	LF351BN	1	1	
U406	IC, HIGH VOLTAGE DISPLAY DRIVERS	504894	56289	UPH-481	1	1	
U407	IC, VOLTAGE REGULATOR, POSITIVE	429647	07263	A78L08AWC	1	1	
U408	IC, LINEAR OP-AMP	288928	12040	LM308AH	3	1	
U409	IC, LINEAR, NEG VOLTAGE REGULATOR	407635	04713	MC7908CT	1	1	
U502	IC, LINEAR OP-AMP	288928	12040	LM308AH	REF		
U503	IC, LINEAR OP-AMP	288928	12040	LM308AH	REF		
U504	IC, OP-AMP, J-FET INPUT	418780	12040	LF351	3	1	
U505	IC, OP-AMP, J-FET INPUT	418780	12040	LF351	REF		
U506	IC, OP-AMP, J-FET INPUT	418780	12040	LF351	REF		
U601Ⓧ	IC, N-CHANNEL SIL GATE, 8-BIT	524496	89536	524496	1	1	
U602Ⓧ	IC, C-MOS, RECIEVER, TRANSMITTER	453464	32293	1M6402CPL	1	1	
U603Ⓧ	IC, C-MOS, HEX D-TYPE FLIP FLOP	404509	12040	MM74C174N	3	1	
U604	IC, MSI, TTL, DECODER/MULTIPLEXER	404152	01295	SN74L154N	1	1	
U605Ⓧ	IC, C-MOS DUAL UP COUNTER	355164	04713	MC14520BCP	1	1	
U607Ⓧ	IC, C-MOS, HEX D-TYPE FLIP FLOP	404509	12040	MM74C174N	REF		
U608Ⓧ	IC, C-MOS, 74C, DUAL "D" F/F	418830	12040	MM74C74	1	1	
U609Ⓧ	IC, LO-POWER SCHOTTKY	404186	01295	SN74LS123N	1	1	
U610	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	1	1	
U611	IC, MOS, TRISTATE HEX BUFFER	407759	12040	MM80C97N	2	1	
U612	IC, MOS, TRISTATE HEX BUFFER	407759	12040	MM80C97N	REF		
U613Ⓧ	IC, TTL, QUAD, 2-INPUT, POS AND GATES	393066	01295	SN74LS08N	1	1	
U614Ⓧ	IC, C-MOS, HEX INVERTER	404699	12040	MM74C04N	REF		
U615	IC, TTL, POS/NAND, HEX INVERTER	394536	01295	SN74LS05	1	1	
U616Ⓧ	IC, C-MOS, HEX INVERTER	404699	12040	MM74C04N	REF		
U617Ⓧ	IC, C-MOS, HEX D-TYPE FLIP FLOP	404509	12040	MM74C174N	REF		
U618-Ⓧ U621Ⓧ	IC, TTL LO-PWR SCHTKY OCTAL "D" TYPE F/F	454892	01295	SN74LS273N	4	1	
U622	IC, HIGH VOLTAGE DISPLAY DRIVERS	504902	56289	UPH-482	3	1	
U623	IC, HIGH VOLTAGE DISPLAY DRIVERS	504902	56289	UPH-482	REF		
U624	IC, HIGH VOLTAGE DISPLAY DRIVERS	504902	56289	UPH-482	REF		
U627	IC, TRANSFORMER, PULSE TYPE, DIP PACKAGE	500298	32997	4252-1034	1	1	
U703	IC, VOLTAGE REGULATOR, 5 VOLT	428847	04713	428847	1	1	
U704	IC, VOLTAGE REGULATOR	413195	04713	MC7812TP	1	1	
U705	IC, VOLTAGE REGULATOR	413187	04713	MC7815CT	1	1	
U706	IC, NEGATIVE VOLTAGE REGULATOR	413179	04713	MC7915CP	1	1	
U707	IC, NEGATIVE VOLTAGE REGULATOR	381665	04713	MC7912CT	1	1	
XK101	SOCKET, RELAY	441964	77342	R10273606	2		
XK102	SOCKET, RELAY	376665	77342	27E501	1		
XK103	SOCKET, RELAY	441964	77342	R10273606	REF		
XQ414	SOCKET, IC, 8-PIN	408450	89536	408450	11		
XQ415	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XS601	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	8		
XU101	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU102	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU103	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU205	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	REF		
XU206-XU209	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU210	SOCKET, IC, 8-PIN	408450	89536	408450	REF		

Table 6-5. A3 Analog PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
XU211	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XU301	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU303	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	REF		
XU401-XU403	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XU404	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	REF		
XU405	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	REF		
XU406	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU408	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XU430	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XU503	SOCKET, IC, 8-PIN	408450	89536	408450	REF		
XU504-XU506	SOCKET, IC, 8-PIN	478016	91506	308-AG39D	REF		
XU601	SOCKET, IC, 40-PIN	418988	91506	340-AG39D	2		
XU602	SOCKET, IC, 40-PIN	418988	91506	340-AG39D	REF		
XU603	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU604	SOCKET, IC, 24-PIN	418970	91506	324-AG39D	1		
XU605	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU607	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU608	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU609	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU611	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU612	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU613	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU614	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU615	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU616	SOCKET, IC, 14-PIN	370304	12040	MM74C906M	REF		
XU617	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU618-XU621	SOCKET, IC, 20-PIN	454421	01295	C932002	4		
XU622-XU624	SOCKET, IC, 18-PIN	418228	91506	318-AG39D	3		
XU627	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU703-XU707	SOCKET, TRANSISTOR	402958	27264	10-18-2031	5		
Y601	CRYSTAL, 6 MHZ	461665	89536	461665	1	1	

NOTE: THE ANALOG PCB ASSEMBLY IS DIVIDED INTO SECTIONS:

-1 INPUT/OUTPUT SWITCHING
(100 SERIES COMPONENTS)

-2 DC BUFFER & DC BUFFER LOGIC
(200 SERIES COMPONENTS)

-3 OHMS CONVERTER
(300 SERIES COMPONENTS)

-4 AC CONVERTER (400 SERIES COMPONENTS)

-5 A/D ANALOG (500 SERIES COMPONENTS)

-6 ANALOG CONTROLLER
(600 SERIES COMPONENTS)

-7 POWER SUPPLY (700 SERIES COMPONENTS)

EACH SECTION HAS ITS' OWN SPECIFIC SERIES.

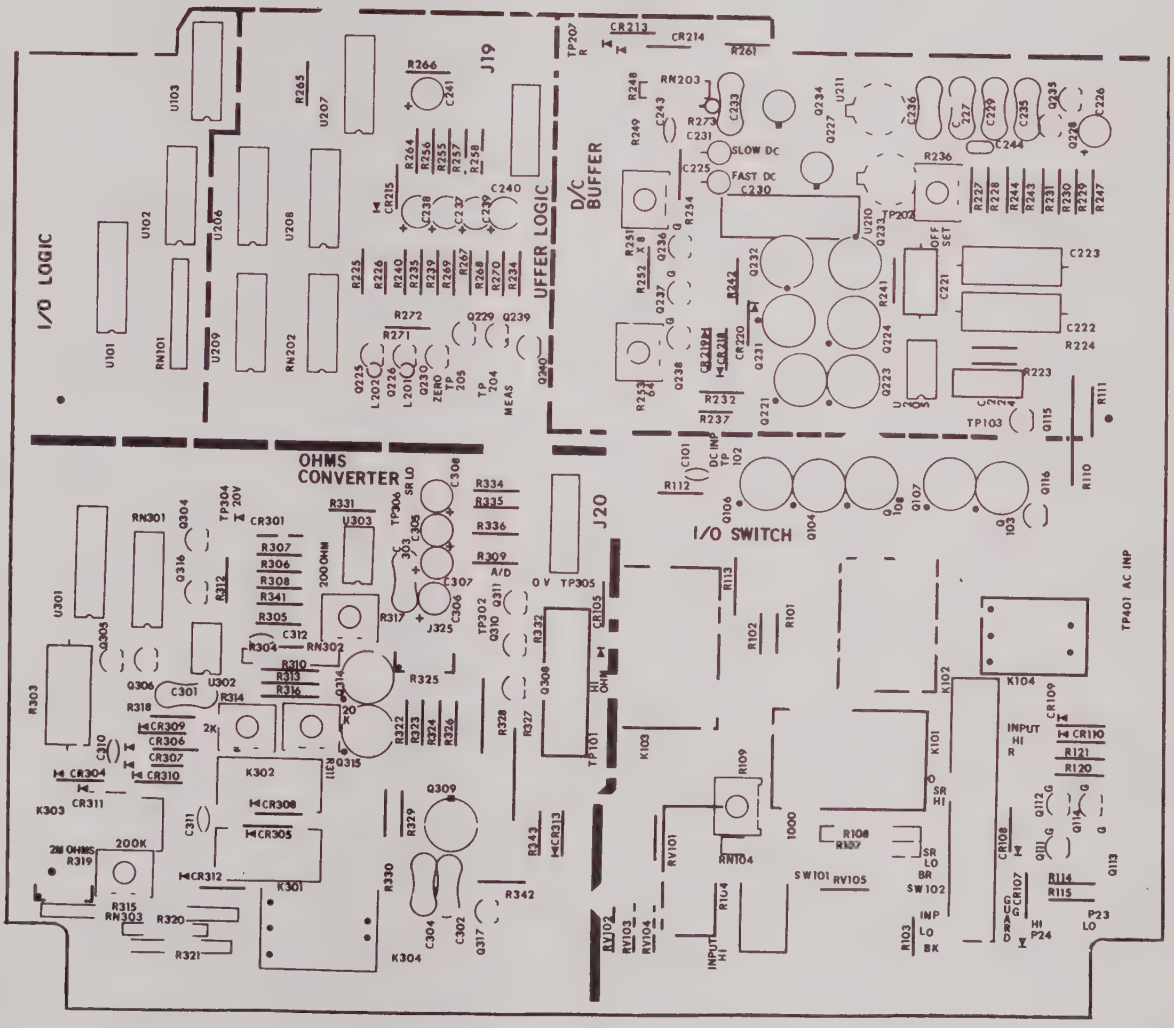


Figure 6-5. A3 Analog PCB Assembly

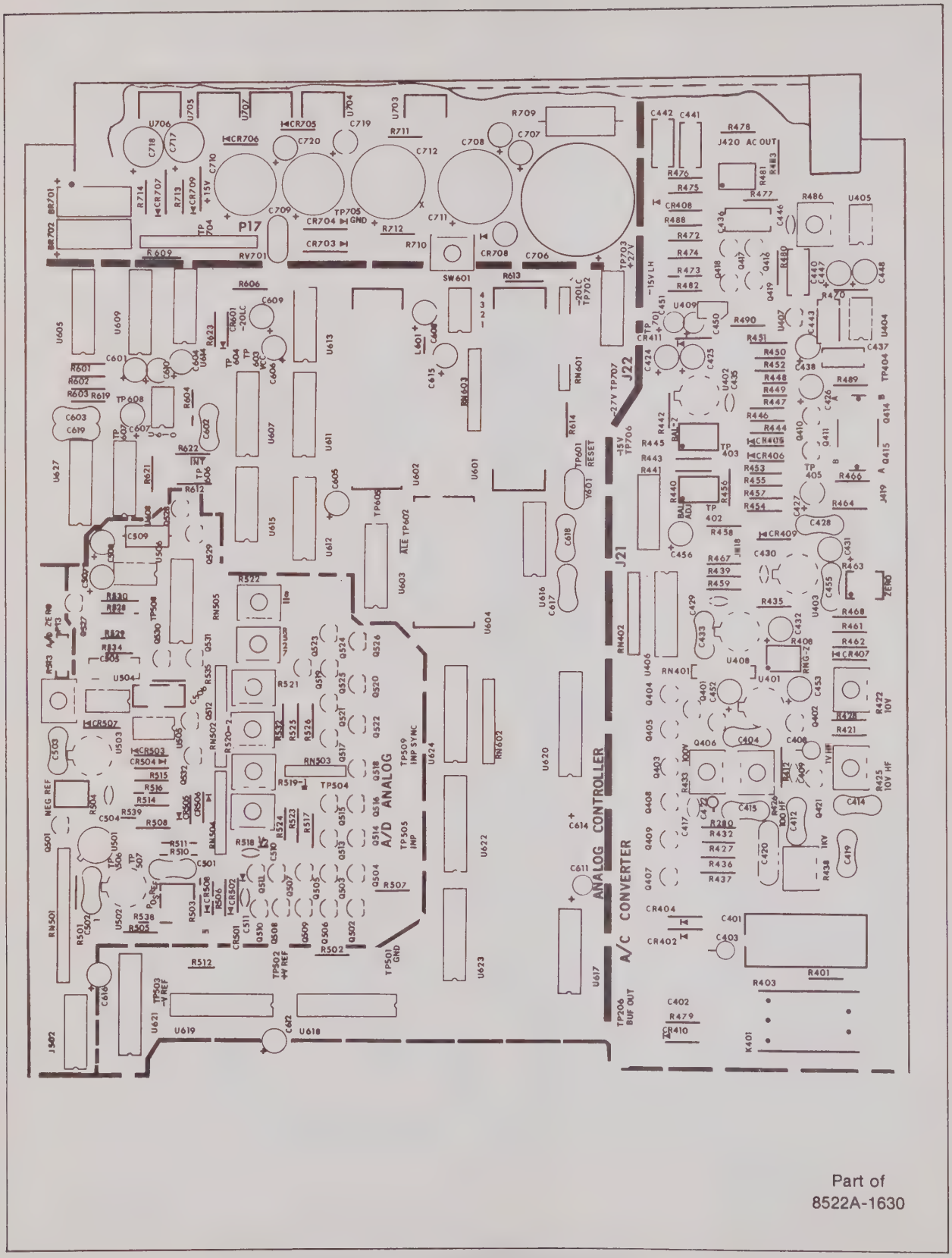
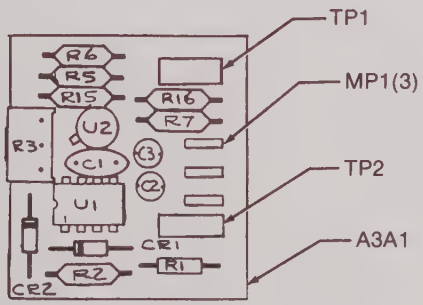


Figure 6-5. A3 Analog PCB Assembly (cont)

Table 6-6. A3A1 Reference Module PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A3A1	REFERENCE MODULE PCB ASSEMBLY FIGURE 6-6 (8520A-4046T)	530626	89536	530626	REF		
C1	CAP, CER, 2000 PF, GMV, 1000V	105569	71590	DA140-139CB	1		
C2	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	2		
C3	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
CR1	DIODE, HI-SPEED SWITCHING	203323	15818	1N4448	2	1	
CR2	DIODE, HI-SPEED SWITCHING	203323	15818	1N4448	REF		
MP1	CONNECTOR, SOCKET	375329	00779	85863-3	3		
MP2	SPACER (W/U2, NOT SHOWN)	152207	07047	10123-DAP	1		
R1	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
R2	RES, MTL. FILM, 3.74K +/-1%, 1/8W	260547	91637	CMF553741F	1		
R3	RES, VAR, 2K +/-10%, 1/2W	285163	89536	285163	1		
R5	RES, MTL. FILM, 15.4K +/-1%, 1/4W	340604	91637	CMF551542F	1		
R6	RES, MTL. FILM, 10.05K +/-1%, 1/8W	340216	89536	340216	1		
R7	RES, MTL. FILM, 4.02K +/-1%, 1/8W	235325	91637	CMF554021	1		
R15	(PART OF REFERENCE AMP SET, U2)				REF		
R16	(PART OF REFERENCE AMP SET, U2)				REF		
TP1	CONNECTOR, TEST POINT, FEMALE	170480	74970	105-752	2		
TP2	CONNECTOR, TEST POINT, FEMALE	170480	74970	105-752	REF		
U1	IC, LINEAR, J-FET	495119	12040	LF358BN	1	1	
U2	REFERENCE AMP SET	523407	89536	523407	1	1	



8520A-1646

Figure 6-6. A3A1 Reference Module PCB Assembly

Table 6-7. A4 Transformer Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A4	TRANSFORMER ASSEMBLY FIGURE 6-7 (8520A-4202)	ORDER	ONLY	REPLACEABLE PARTS			
A4A1	TRANSFORMER PCB ASSEMBLY	496844	89536	496844	1		
H1	SCREW, PHP, 8-32 X 1/4	228890	89536	228890	4		
MP1	BRACKET, TRANSFORMER, FRONT	491118	89536	491118	1		
MP2	BRACKET, TRANSFORMER, REAR	491126	89536	491126	1		
MP3	GROMMET, RUBBER	100065	83330	2174	1		
T1	TRANSFORMER	490797	89536	490797	1		
A4A1	TRANSFORMER PCB ASSEMBLY FIGURE 6-7 (8520A-4040)	ORDER	ONLY	REPLACEABLE PARTS	REF		
C1	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	2		
C2	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW3C0C224K	REF		
C3	CAP, CER, 1.0 UF +/-20%, 50V	436782	72982	8131-050-601-105M	1		
CR1	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	2		1
CR2	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	REF		
L1	CHOKE, 0.200 MH	492116	89536	492116	1		
P1	CONNECTOR	512889	00779	62395-1	2		
P2	CONNECTOR	512889	00779	62395-1	REF		
RV1	VARISTOR, 33V	485391	89536	485391	1		
RV2	VARISTOR, 22V	500777	89536	500777	1		
S1	SWITCH, SLIDE, DPDT	234278	89536	234278	2		1
S2	SWITCH, SLIDE, DPDT	234278	89536	234278	REF		

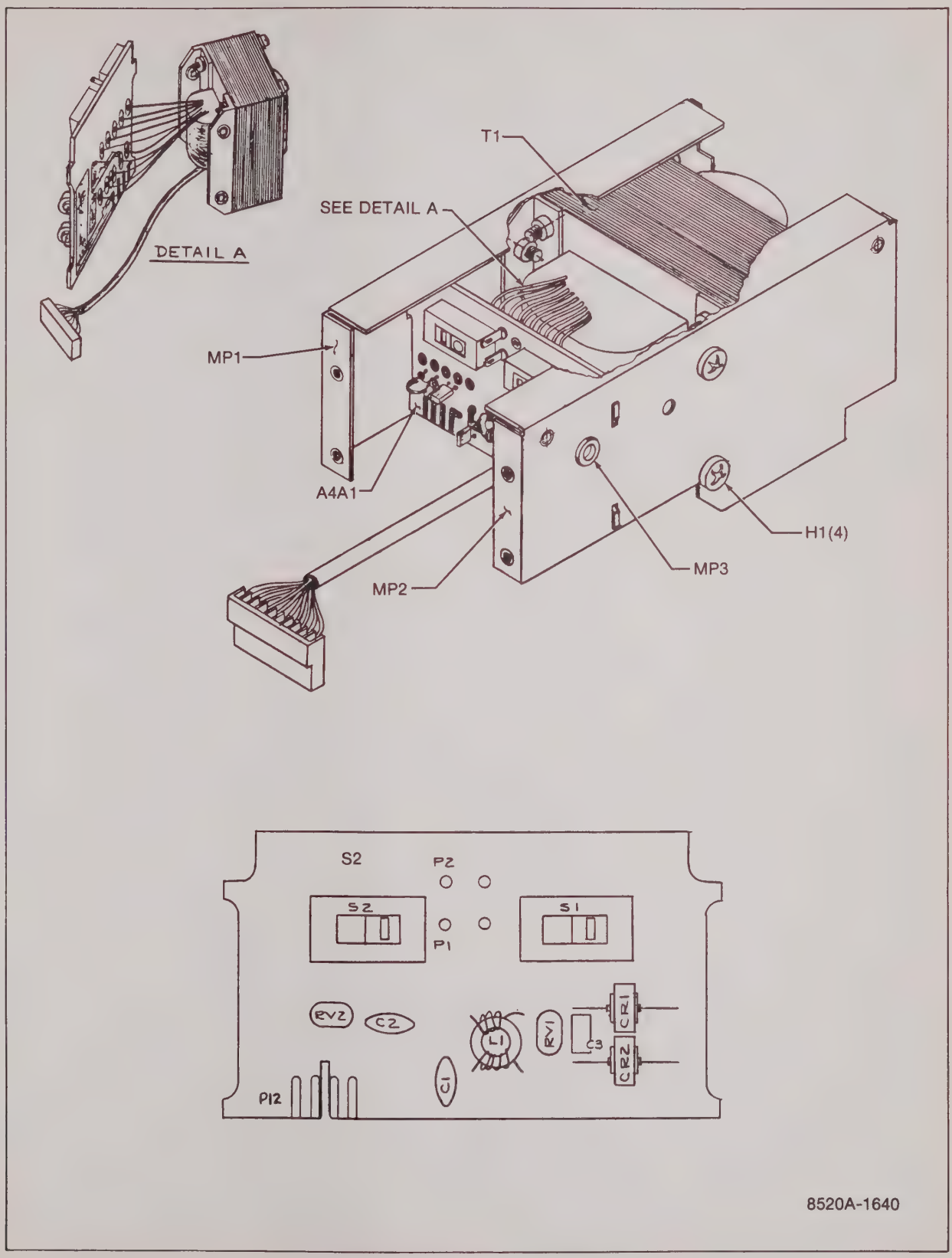


Figure 6-7. A4 Transformer Assembly

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

U.S. SALES AREAS

AK, Anchorage
Harry Lang & Associates
1371 Hillcrest Drive #303
Anchorage, AK 99503
(907) 279-5741

AL, Huntsville
John Fluke Mfg. Co., Inc.
3322 S. Memorial Parkway
Suite 96
Huntsville, AL 35801
(205) 881-6220
(404) 396-3224 (Atlanta)

AZ, Tempe
John Fluke Mfg. Co., Inc.
2125 S. 48th Street
Suite 104
Tempe, AZ 85282
(602) 967-8724
(602) 790-9881 (Tucson)

CA, Los Angeles
John Fluke Mfg. Co., Inc.
20902 South Bonita St.
Carson, CA 90746
(213) 538-3900 or
(714) 761-2449

CA, Santa Clara
John Fluke Mfg. Co., Inc.
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-0513

CA, Tustin
John Fluke Mfg. Co., Inc.
15445 Red Hill Ave., Suite F
Tustin, CA 92680
(714) 838-8863
(714) 226-1254 (San Diego)

CO, Denver
John Fluke Mfg. Co., Inc.
1980 South Quebec St. #4
Denver, CO 80231
(303) 750-1222

CT, Hartford
John Fluke Mfg. Co., Inc.
124 Hebron Ave.
Glastonbury, CT 06033
(203) 633-0777

FL, Orlando
John Fluke Mfg. Co., Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

GA, Atlanta
(404) 396-3224

HI, Honolulu
EMC Corporation
2979 Ualena St.
Honolulu, HI 96819
(808) 836-1138

IA, Iowa City
(319) 354-2811

IL, Chicago
John Fluke Mfg. Co., Inc.
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-0850

IN, Indianapolis
John Fluke Mfg. Co., Inc.
5610 Crawfordsville Rd.
Corporate Square West
Suite 802
Indianapolis, IN 46224
(317) 244-2456

KA, Kansas City
John Fluke Mfg. Co., Inc.
4550 West 109th St.
Suite 130
Shawnee Mission, KA 66211
(913) 381-9800

LA, New Orleans
(504) 455-0814

MA, Burlington
John Fluke Mfg. Co., Inc.
25 "B" Street
Burlington, MA 01803
(617) 273-4674

MD, Rockville
John Fluke Mfg.Co., Inc.
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570
(301) 792-7060 (Baltimore)

MI, Detroit
John Fluke Mfg. Co., Inc.
13955 Farmington Rd.
Livonia, MI 48154
(313) 522-9140

MN, Minneapolis
John Fluke Mfg. Co., Inc.
7373 West 147th St.
Suite 196
Apple Valley, MN 55124
(612) 432-9400

MO, St. Louis
John Fluke Mfg. Co., Inc.
300 Brookes Dr., Suite 100
Hazelwood, MO 63042
(314) 731-3388

NC, Greensboro
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
John Fluke Mfg. Co., Inc.
P.O. Box 930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

NM, Albuquerque
John Fluke Mfg. Co., Inc.
1108 Alvarado Drive N.E.
Albuquerque, NM 87110
(505) 265-8431

NY, Rochester
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 266-1400

OH, Cleveland
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

OH, Dayton
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238
(614) 889-5715 (Columbus)

OR, Portland
John Fluke Mfg. Co., Inc.
18360 S.W. Springfield Lane
Aloha, OR 97007
(503) 642-1342

PA, Philadelphia
John Fluke Mfg. Co., Inc.
1010 West 8th Ave., Suite H
King of Prussia, PA 19406
(215) 265-4040
(412) 261-5171 (Pittsburgh)

TX, Austin
John Fluke Mfg. Co., Inc.
Creek Gardens, Suite 103
8705 Shoal Creek Blvd.
Austin, TX 78758
(512) 459-3344

TX, Dallas
John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75234
(214) 233-9990

TX, Houston
John Fluke Mfg. Co., Inc.
4240 Blue Bonnet Dr.
Stafford, TX 77477
(713) 491-5995
(504) 455-0814 (New Orleans)

UT, Salt Lake City
John Fluke Mfg. Co., Inc.
5226 So. 300 West, Suite #2
Salt Lake City, UT 84107
(801) 268-9331

WA, Seattle
John Fluke Mfg. Co., Inc.
975 Industry Drive
Seattle, WA 98188
(206) 575-3765

For more information on Fluke products or Sales Offices you may dial (800) 426-0361 toll-free in most of U.S.
From Alaska, Hawaii, or Washington phone (206) 356-5400. From other countries phone (206) 356- 5500.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973
Litho in U.S.A. 12/81

FLUKE®

INTERNATIONAL SALES OFFICES

Argentina ●
Coasin, S.A.
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 5523185, TLX: 390122284

Australia ●
Elmeasco Instruments Pty Ltd.
P.O. Box 30, Concord, N.S.W.
Australia 2137
Tel: (2) 736-2888, TLX: AA25887

Elmeasco Instruments Pty Ltd.
P.O. Box 107
Mt. Waverly, VIC. 3149
Australia
Tel: 233-4044
TLX: 36206 (ELMVIC)

Elmeasco Instruments Pty Ltd.
Professional Suite's Bldg.
G.P.O. Box 2360
Brisbane, 4001, Australia
Tel: (07) 229-3161

Elmeasco Instruments Pty Ltd.
P.O. Box 1240
G.P.O. Adelaide 5001
South Australia

Elmeasco Instruments Pty. Ltd.
P.O.Box 95, Gosnells
West Australia 6110
Tel: (09) 348-3362

Austria ■
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertrieb-KG., Obachgasse 28
A-1220 Vienna, Austria
Tel: (0222) 235555, TLX: 134759

Bahrain ■
AL-Hamidiya
P.O. Box 20074
Manama, Bahrain
Tel: 259958, TLX: 8895

Bangladesh ●
Motherland Corporation
24 Hatkhola Rd., Tikatuli
Dacca 3, Bangladesh
Tel: 257249, 255776

Belgium ■
Fluke (Belgium) S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: (2) 2164090, TLX: 26312

Bolivia ●
Coasin Bolivia S.R.L.
Casilla 7295, La Paz, Bolivia
Tel: 40962, TLX: 5255

Brazil ●
Fluke Brasil-Industria E
Commercio LTDA
Al. Amazonas 422,
Alphaville, Barueri,
CEP 06400 Sao Paulo, Brazil
Tel: (011) 421-3603

Brunei ●
Rank O'Connor's (PTE) Limited
No. 8, BK.D
Surfri Shop House Complex
Mile 1, Jalong Tutong
Bandar Seri Begawan, Brunei
Tel: 26680

Bulgaria ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Canada ●
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E.
Calgary, Alberta T2E 6Z5
Tel: (403) 230-1341, TLX: 03-821186

Allan Crawford Assoc., Ltd.
Suite 1, Box 60
Edmonton, Alberta T5L 4H8
Tel: (403) 451-4893

Allan Crawford Assoc., Ltd.
3795 William Street
Burnaby, British Columbia V5C 3H3
Tel: (604) 294-1326, TLX: 04-54247

Allan Crawford Assoc., Ltd.
192 Joseph Zatzman Dr.
Suite 4
Burnside Industrial Park
Dartmouth, Nova Scotia B3B 1N4
Tel: (902) 463-8640, TLX: 01931604

Allan Crawford Assoc., Ltd.
881 Lady Ellen Place
Ottawa, Ontario K1Z 5L3
Tel: (613) 722-7682, TLX: 0533600

Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario L4V 1J5
Tel: (416) 678-1500, TLX: 06968769

Allan Crawford Assoc., Ltd.
7918 cote de Liesse
St. Laurent, Quebec H4T 1E7
Tel: (514) 731-8564, TLX: 05824944

Chad ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Chile ●
Intronica Chile Ltda.
Manuel Montt 024 - Of. D
Casilla 16228, Santiago 9, Chile
Tel: 44940
TLX: No 40301 Cab. Publ.,
Attn: Intronica Chile

China, People's Republic of ●
Fluke International Corporation
P.O. Box C9090
Everett, WA 98206, U.S.A.
Tel: (206) 356-5511
TLX: 152662 JOHN FLUKE EVT

Colombia ●
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aereo 29583
Bogota DE, Colombia SA
Tel: 232-45-32, TLX: 45787

Cyprus ■
Chris Radiovision Ltd.
P.O. Box 1989, Nicosia, Cyprus
Tel: 66121, TLX: 3495

Czechoslovakia ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Denmark ■
Tage Olsen A/S
Ballerup Byvej 222
DK - 2750 Ballerup, Denmark
Tel: (2) 658111, TLX: 35293

Ecuador ●
Proteco Coasin Cia., Ltda.
Edificio "Jerico"
Ave. 12 de Octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 529684, TLX: 2865 Protec Ed

Proteco Coasin Cia., Ltda.
Calderon 103Y Malecon
Casilla #9733
Guayaquil, Ecuador
Tel: 526093

Egypt and Sudan ■
Electronic Engineering Liaison Office
P.O. Box 2891 Horreya
11 Ahmed Khashara St.
Hegas Square
Heliopolis, Cairo, Egypt
Tel: 691588, TLX: 92502

Ethiopia ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Fiji ●
AWA Fiji
P.O. Box 858
47 Forster Road, Walu Bay
Suva, Fiji
Tel: 312079, TLX: FJ2347

Finland ■
Oy Findip AB, Teollisuustie 7
02700 Kauniainen, Finland
Puh: (0) 5052255
TLX: 123129

France ■
M.B. Electronique S.A.
Rue Fourny 606, Z1 Centre
78530 BUC
B.P. No. 31
78530 BUC, France
Tel: (3) 9568131, TLX: 695414

German Democratic Republic ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

German Federal Republic ■
Fluke (Deutschland) GmbH
Max-Hueber StraBe 8
8045 Ismaning, West Germany
Tel: (089) 96251, TLX: 522472
Rapifax: (089) 966718

Fluke (Deutschland) GmbH
Meineckestrasse 53
4000 Dusseldorf 30, West Germany
Tel: (0211) 450831, TLX: 8585576

Fluke (Deutschland) GmbH
Oberer Kirchhaldenweg 135
7000 Stuttgart 1, West Germany
Tel: (0711) 694091, TLX: 722518

Fluke (Deutschland) GmbH
Hubertusallee 46
1000 Berlin-33, West Germany
Tel: (030) 8911090
TLX: 0184978

Greece ■
Hellenic Scientific Representations Ltd.
11, Vrasside Street
Athens 612, Greece
Tel: (1) 711140, TLX: 219330

Hong Kong ●
Schmidt & Co. (H.K.) Ltd.
28th F1. Wing on Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644
TLX: 74766 SCHMC HX

Hungary ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Iceland ●
Kristjan O. Skagfjord Ltd.
P.O. Box 906
Reykjavik, Iceland
Tel: 24120, TLX: 2133

India ●
Hinditron Services Pvt. Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 811316,
TLX: 112326 Hspl In

Hinditron Services Pvt. Ltd.
33/44-A 8th Main Road
Raj Mahl Vilas Extension
Bangalore 560 080, India
Tel: 33139
TLX: 0845741

Hinditron Services Pvt. Ltd.
Shantiniketan, Office No.6
6th Floor, 8 Camac Street
Calcutta 700 017, India
Tel: 434032, 447541

Hinditron Services Pvt. Ltd.
15 Community Centre, Panchshila Park
New Delhi 110 017, India
Tel: 653397

Hinditron Services Pvt. Ltd.
Srinath Complex, 5th Floor
1-1-58/1 to 1-1-58/11
Sarojini Devi Road
Secunderabad 500 003, India
Tel: 61705

Indonesia ●
P.T. Dwi Tunggal Jaya Sakti
Sangga Buana Bldg., 1st Floor
Jl. Senen Raya 44, P.O. Box 4435
Jakarta, Indonesia
Tel: 367390-9, TLX: 46624

Iran ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Iraq ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Ireland ■
Euro Electronics
32 Brews Hill
Naven County Meath, Ireland
Tel: (46) 23577, TLX: 3182

Israel ■
R.D.T. Electronics Engineering Ltd.
P.O. Box 75
46, Sokolov Street
Ramat Hasharon 47235, Israel
Tel: (3) 483216, TLX: 32143

FLUKE®

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973

Litho in U.S.A. 12/81

Italy ■
Sistrel S.p.A.
Via Giuseppe Armellini No. 37
00143 Rome, Italy
Tel: (6) 5915551, TLX: 68356

Sistrel S.p.A.
Via Pelizza da Volpedo 59
20092 Cinisello besamo
Milan, Italy
Tel: (2) 6181893, TLX: 334643

Sistrel S.p.A.
Via Cintia Parco S. Paolo 35
80126 Naples, Italy
Tel: (81) 7679700

Japan ●
John Fluke Mfg. Co., Inc.
Japan Branch
(PC Board Testers only)
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5425
TLX: 3823-666 FLKJPJ

Tokyo Electron Ltd.
38 FL Shinjuko Nomura Bldg.
1-26-2, Nishi-Shinjuku
Shinjuku-ku
Tokyo 160, Japan
Tel: 03-343-4411, TLX: 2322220

Kenya ●
ADCOM Ltd.
P.O. Box 30070
Nairobi, Kenya, East Africa
Tel: 331955, TLX: 22639

Korea ●
Electro-Science Korea Co.
C.P.O. Box 8446
Room 201, Boondo Bldg.
56-12 Jangchung-IKa
Jung-ku
Seoul, Korea
Tel: 261-7702, TLX: K25381

Kuwait ■
Tareq Company
P.O. Box Safat 20506
Kuwait, Arabian Gulf
Tel: 436100/436045
TLX: 2315

Lebanon and Jordan ■
Mabek (Electronic Division)
P.O. Box 13-5657
Beirut, Lebanon
Tel: 812523/812538
TLX: 22889

Libya ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Malaysia ●
Rank O'Connor's (PTE) Limited
P.O. Box 91, Petaling Jaya
Selangor, West Malaysia
Tel: 566599
TLX: OCONOR MA37649

Rank O'Connor's (PTE) Limited
Lot No. 5 Taman Mesra
Mile 3, Jalan Penampang
Kota Kinabulu, East Malaysia
Tel: 55322, TLX: MA80286

Mexico ●
Christensen S.A.
Guillermo Prieto 76-304
Col. San Rafael
Delegacion Cuahutemoc
06470—Mexico, D.F.
Tel: 546-25-95/546-29-55
TLX: 017-75612

Morocco ■
Mainvest
Residence Moulay Ismail, Bat. C.
12, Place des Alaouites
Rabat, Morocco
Tel: (7) 23990, TLX: 31036

Nepal ●
Associated Enterprises
GPO Box 790, Pyaphal Tole
Kathmandu, Nepal
Tel: 13868

Netherlands ■
Fluke (Nederland) B.V.
Zonnebaan 39
3606 CH Maarssen, The Netherlands
P.O. Box 225
3600 AE Maarssen, The Netherlands
Tel: (030) 436514, TLX: 47128

New Zealand ●
McLean Information Technology
P.O. Box 18-065, Glen Innes
Auckland, New Zealand
Tel: 587-037, TLX: NZ 2763

W & K McLean Ltd.
P.O. Box 496
Wellington, New Zealand
Tel: 851-450

Nigeria ●
Mofat Engineering Co., Ltd.
P.O. Box 6369
Lagos, Nigeria
Tel: 960744, TLX: 20202

Norway ■
Morgenstierne & Co A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: (2) 356110, TLX: 71719

Pakistan ●
Pak International Operations
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323, Karachi, Pakistan
Tel: 221127, TLX: 24494

PDR Yemen ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Peru ●
Importaciones Y Representaciones
Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650, TLX: 37425663

Phillipines ●
Spark Radio & Electric Supply
P.O. Box 610, Greenhills, San Juan
M. Manila, Phillipines
Tel: 78-78-16
TLX: 27901 RLA PH

Poland ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Portugal ■
Decada-Equipamentos de
Electronica, Lda.
Rue Pedro Nunes, 47-C
1000 Lisboa
P.O. Box 1128, 1003 Lisboa Codex
Tel: (19) 574984, TLX: 18469

Qatar ■
Technology Organisation
P.O. Box 5549, Doha, Qatar
Tel: 321431, TLX: 4581

Romania ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Saudi Arabia ■
Electronic Equipment Marketing Co. Ltd.
P.O. Box 3750
Riyadh, Saudi Arabia
Tel: (1) 4032761, TLX: 201120

Singapore ●
Rank O'Connor's (PTE) Limited
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944
TLX: OCONSIN RS21023

Somalia ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

South Africa ●
Fluke S.A. (Pty) Ltd.
P.O. Box 39797, Bramley 2018
Republic of South Africa
Tel: (011) 786-3170, TLX: 424328

Spain ■
Hispano Electronica S.A.
Poligono Industrial Urtinsa
Apartado de Correos 48
Alcorcon (Madrid), Spain
Tel: (1) 6194108
TLX: 22404/42634

Sri Lanka ●
Jay-Es Electronics
160 Poorvarama Mawatha
Colombo 5, Sri Lanka
Tel: 073-2393

Sweden ■
Teleinstrument AB
P.O. Box 4490
162 04 Vallingby, Sweden
Tel: (8) 380370, TLX: 11347

Switzerland ■
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich, Switzerland
Tel: (1) 2010711, TLX: 54318

Syria ■
Mabek (Electronic Division)
P.O. Box 4238
Damascus, Syria

Taiwan ●
Schmidt Scientific Far East Ltd.
906, Chia Hsin Bldg.
96, Chung Shan N. Rd., Sec. 2
Taipei, Taiwan,
Tel: 5817393/5814976
TLX: 11111

Thailand ●
Measuretronix Ltd.
1899/10 Ramkamhaeng Rd.
Huamark, Bangkok, Thailand
Tel: 3143369, TLX: 81143

Tunesia ■
Selep S.A.R.L.
6, Rue de Sparte
Tunis - 1000 RP, Tunesia
Tel: (1) 248093, TLX: 13030

Turkey ■
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatibey Cad 92/3
Karakoy, Istanbul, Turkey
Tel. (1) 5461
TLX: 23353

United Arab Emirates ■
Al-Sanani Ge. Trad. Est.
P.O. Box 7187
Abu-Dhabi, United Arab Emirates
Tel: 828428/821370/821371/
TLX: 23966

United Kingdom ■
Fluke (Great Britain) Ltd.
Colonial Way
Watford, Herts, WD2 4TT
United Kingdom
Tel: (0923) 40511, TLX: 934583
Rapifax: (0923) 25067

Uruguay ●
Coasin Uruguaya S.R.L.
Cuareim 2196
Casilla de Correos 1400
Correo Central
Montevideo, Uruguay
Tel: 29-31-95, TLX: UY5671

U.S.S.R. ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Venezuela ●
Coasin, C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Piso 3, La Urbina
Apartado De Correos
NR-70.136 Los Ruices
Caracas 1070A, Venezuela
Tel: 38-78-42, TLX: 21027 Emven Ve

Yemen ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Yugoslavia ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT 15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

■ Supplied and Supported by —
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

● Supplied and Supported by —
Fluke International Corporation
P.O. Box C9090
Everett, WA 98206 U.S.A.
Tel: (206) 356-5500
TLX: 152662 JOHN FLUKE EVT

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973
Litho in U.S.A. 12/81

FLUKE®

TECHNICAL SERVICE CENTERS

U.S. & Canada

CA, Burbank
Fluke Technical Center
2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-4641

CA, Santa Clara
Fluke Technical Center
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95050
(408) 727-8121

CO, Denver
Fluke Technical Center
1980 S. Quebec St., Unit 4
Denver, CO 80231
(303) 750-1228

FL, Orlando
Fluke Technical Center
940 N. Fern Creek Avenue
Orlando, FL 32803
(305) 896-2296

IL, Rolling Meadows
Fluke Technical Center
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-5800

MA, Burlington
Fluke Technical Center
25 "B" Street
Burlington, MA 01803
(617) 273-4678

MD, Rockville
Fluke Technical Center
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1576

NJ, Paramus
Fluke Technical Center
West 75th Century Road
Paramus, NJ 07652
(201) 262-9550

TX, Dallas
Fluke Technical Center
14400 Midway Road
Dallas, TX 75240
(214) 233-9945

WA, Everett
Fluke Technical Center
6920 Seaway Blvd.
Everett, WA 98206
(206) 356-5560

ALB, Calgary
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E.
Calgary, Alberta T2E 6Z5
(403) 230-1341

ONT, Mississauga
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario 1.4V IJ2
(416) 678-1500

QUE, Montreal
Allan Crawford Assoc., Ltd.
7018 Cote de Liesse
Montreal, Quebec H4T IE7
(514) 731-8564

B.C., Burnaby
Allan Crawford Assoc. Ltd.
3795 William St.
Burnaby, B.C. V5C 3H3
(604) 294-1326

Other Areas

Argentina
Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 522-5248

Australia
Elmeasco Instruments Pty Ltd.
P.O. Box 30
Concord, N.S.W.
Australia 2137
Tel: (02) 736-2888

Australia
Elmeasco Instruments Pty. Ltd.
P.O. Box 107
Mr. Waverly, VIC 3149
Australia
Tel: (03) 2334044

Australia
Elmeasco Instruments Pty. Ltd.
GPO Box 2360
Brisbane, Queensland 4001
Australia
Tel: (07) 229-3161

Austria
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertriebs-KG., Obachgasse 28
A-1220 Vienna, Austria
Tel: (0222) 235555

Belgium
Fluke (Belgium) S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: 09-32-2-2164090

Brazil
Fluke Brasil-Industria e Comercio Ltda.
Al. Amazonas 422, Alphaville, Barueri
CEP 06400 Sao Paulo, Brazil
Tel: (011) 421-3603

Chile
Intronica Chile Ltda.
Casilla 16228
Santiago 9, Chile
Tel: 44940

China, Peoples Republic of
Beijing Radio Research Institute
Dianmen East Avenue 89
Beijing, China
Tel: 445612

Colombia
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aero 29583
Bogota DE, Colombia S.A.
Tel: 232-45-32

Denmark
Tage Olson A/S
Ballerup Byvej 222
DK-2750 Ballerup
Denmark
Tel: 09-45-2-658111

Ecuador
Proteco Coasin Cia., Ltda.
Edificia "Jerico"
Ave. 12 de Octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 526759

Egypt and Sudan
Electronic Engineering Liaison Office
11 Ahmed Khashaba Street
Hegas Square
Heliopolis, Cairo, Egypt
Tel: 691588

Finland
Oy Findip AB
Teollisuustie 7
02700 Kauniainen
Finland
Tel: 09-358-0-502255

France
M.B. Electronique S.A.
Rue Fourny
ZAC de BUC
B.P. No. 31
78530 BUC, France
Tel: 09-33-1-9568131

Greece
Hellenic Scientific
Representations Ltd.
11, Vrassida Street
Athens 612, Greece
Tel: 09-30-1-711140

Hong Kong
Schmidt & Co (H.K.) Ltd.
28th Fl. Wing On Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644

India
Hinditron Services Pvt. Ltd.
Field Service Centre
8th Main Road
33/44-A Raj Mahal Vilas Extn.
Bangalore 560 080, India
Tel: 33139

India
Hinditron Services Pvt. Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 811316

India
Hinditron Services Pvt. Ltd.
15, Community Centre
Panchshila Park
New Delhi, India 110-017
Tel: 619118

Israel
R.D.T. Electronics Engineering Ltd.
P.O. Box 75
46, Sokolov Street
Ramat Hasharon 47235
Israel
Tel: 09-972-3-483211

Italy
Sistrel S.p.A.
Via Pelizza da Volpedo 59
20092 Cinisello Besamo
Milan, Italy
Tel: (2) 6181893

Italy
Sistrel S.p.A.
Via Giuseppe Armellini No. 37
00143 Rome, Italy
Tel: 09-39-6-5915551

Japan
John Fluke Mfg. Co., Inc.
Japan Branch
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5428

Korea
Electro-Science Korea Co.
C.P.O. Box 8446
Room 201, Boondo Bldg.
56-12, Gangchung-1 Ka
Gung-Ku
Seoul, Korea
Tel: 261-7702

Malaysia
Rank O'Connor's (Malaysia) SDN. BHD.
P.O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel: 566599

Mexico
Christensen S.A.
Guillermo Prieto 76-304
Col. San Rafael
Delegacion Cuahutemoc
06470-Mexico, D.F.
Tel: 546-25-95

Netherlands
Fluke (Nederland) B.V.
Zonnebaan 39
3606 CH Maarssen, The Netherlands
P.O. Box 225
3600 AE Maarssen, The Netherlands
Tel: (030) 436514

New Zealand
McLean Information Technology Ltd.
P.O. Box 18065
Glen Innes
Auckland 6, New Zealand
Tel: 587-037

Norway
Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 09-47-2-356110

Pakistan
Pak International Operations
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323
Karachi-2 Pakistan
Tel: 221127/239052

Peru
Importaciones Y Representaciones
Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650

Phillipines
Spark Radio and Electronics Corp.
P.O. Box 610 Greenhills
Metro Manila, Philippines 3113
Tel: 78-78-16

Portugal
Equipamentos de Laboratorio, Ltda.
P.O. Box 1128
Lisbon 1000, Portugal
Tel: 09-351-19-574984

Republic of Singapore
Rank O'Connor's (PTE) Ltd.
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944

Republic of South Africa
Fluke S.A. (Pty) Ltd.
P.O. Box 39797
Bramley 2018
Republic of South Africa
Tel: (011) 786-3170

Spain
Hispano Electronics S.A.
Apartado de Correos 48
Alcorcon (Madrid)
Spain
Tel: 09-34-1-6194108

Sweden
Teleinstrument AB
P.O. Box 4490
S-162 04 Vallingby 4
Sweden
Tel: -09-46-8-380370

Switzerland
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich
Switzerland
Tel: 09-41-1-2010711

FLUKE®

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973

Litho in U.S.A. 12/81

Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manaul to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			–	A	B	C	D	E	F	G	H	J	K	L	M	N	P	T							
A1	Display PCB Assembly	516625	–																						
A2	Digital Controller PCB Assembly	608729	–																						
A2A1	Parallel/BCD I/O PCB Assembly	629030	–																						
A3	Analog PCB Assembly	496844		●	●	●	●	●	●	●	●	●	●	●	●	●	●	X							
A3A1	Reference Module PCB Assembly	530626	–																						
A4A1	Transformer PCB Assembly	496836		●	●	●	●	X																	

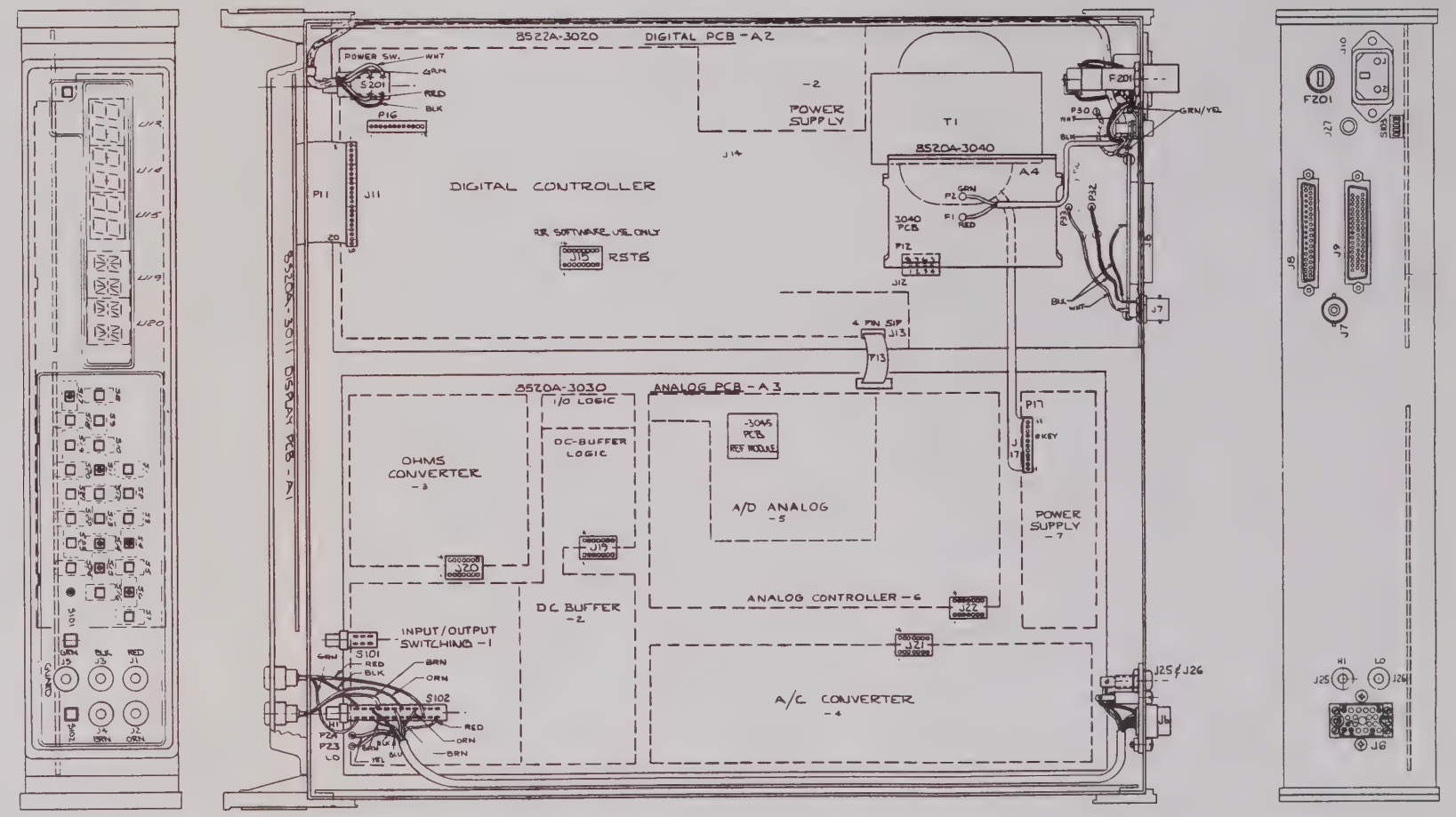
* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
– = No revision letter on the PCB.

Section 8
Schematic Diagrams

TABLE OF CONTENTS

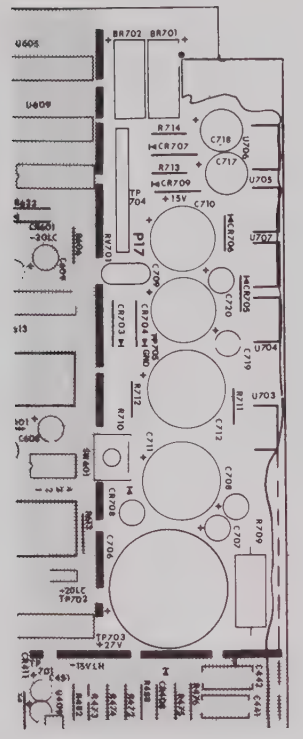
FIGURE	TITLE	PAGE
8-1.	Assembly Placement	8-3
8-2.	Power Supply	8-4
8-3.	Display PCB Assembly	8-6
8-4.	Digital (Controller) PCB Assembly	8-8
8-5.	Remote Interface	8-12
8-6.	Input/Output Switching	8-16
8-7.	DC Buffer	8-18
8-8.	Ohms Converter	8-20
8-9.	AC Converter	8-22
8-10.	A/D Analog	8-24
8-11.	Analog Controller	8-26
8-12.	Reference Module PCB Assembly	8-29

NOTES:

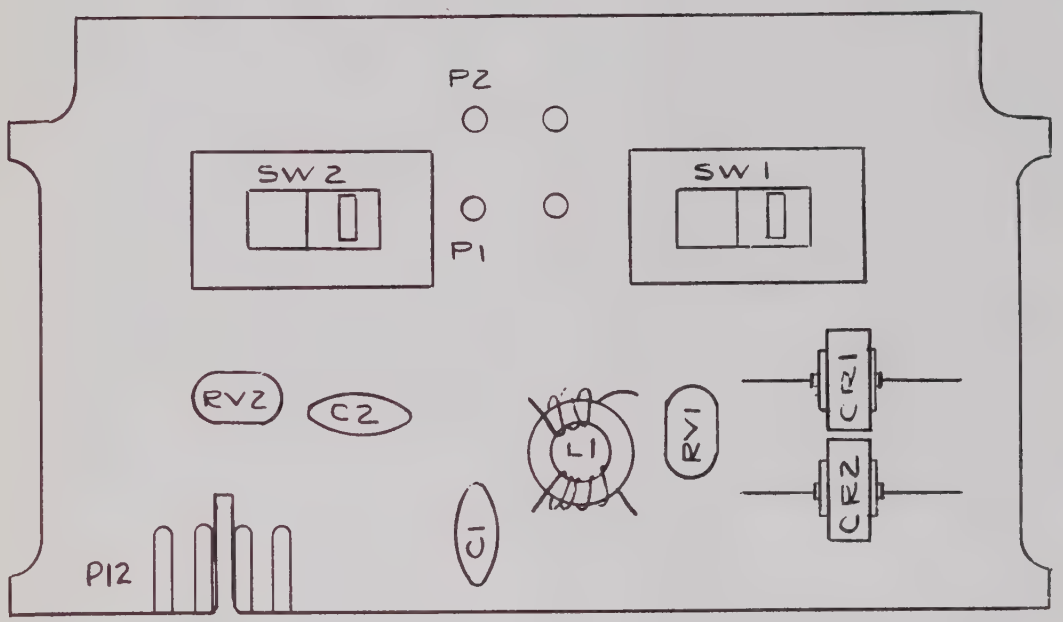


8522A-1303

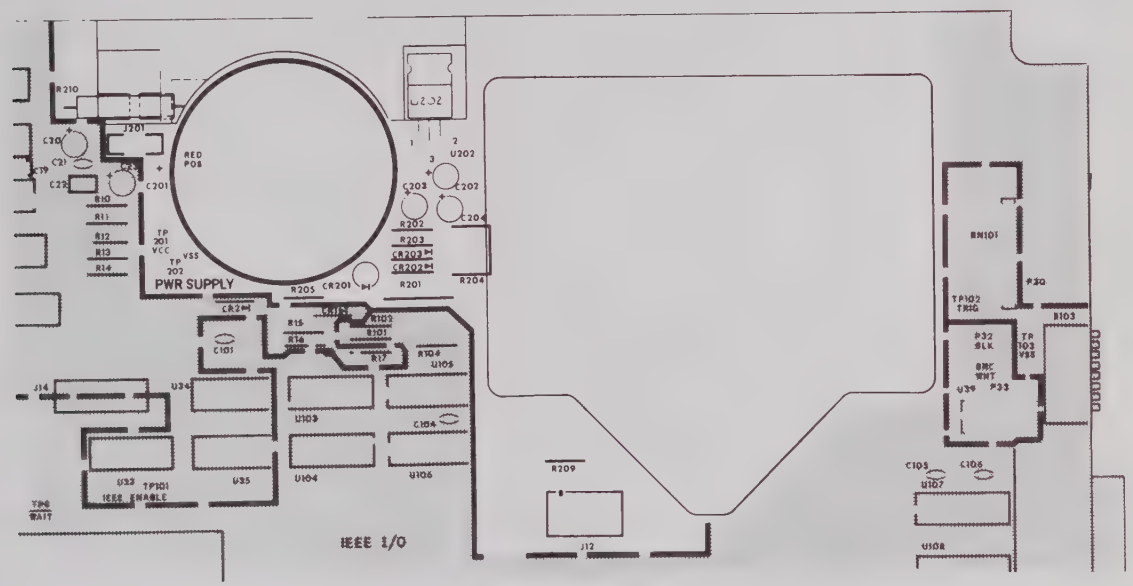
Figure 8-1. Assembly Placement



Part of
8520A-1630

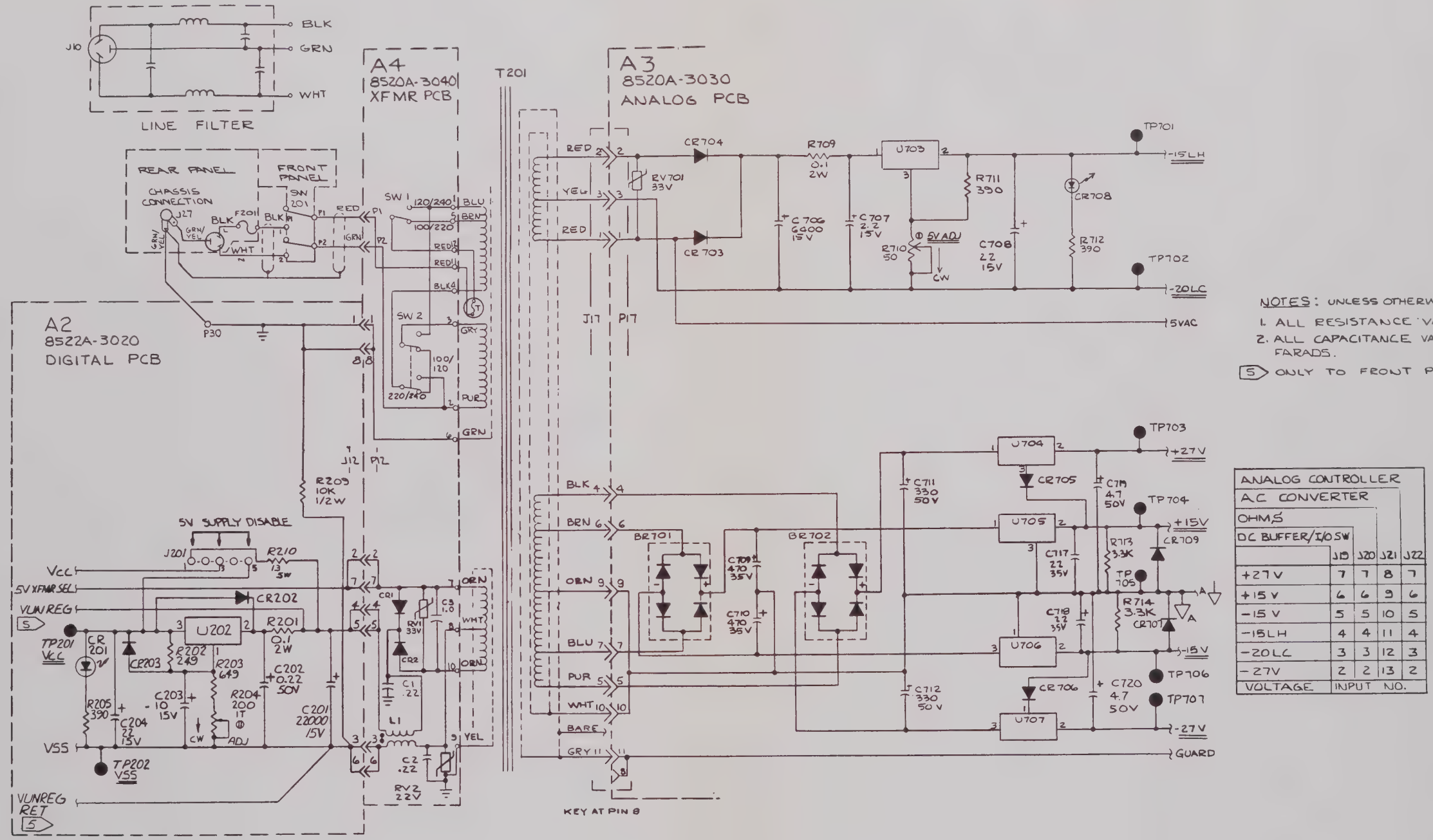


8520A-1640



Part of
8520A-1620

Figure 8-2. Power Supply



NOTES: UNLESS OTHERWISE SPECIFIED:

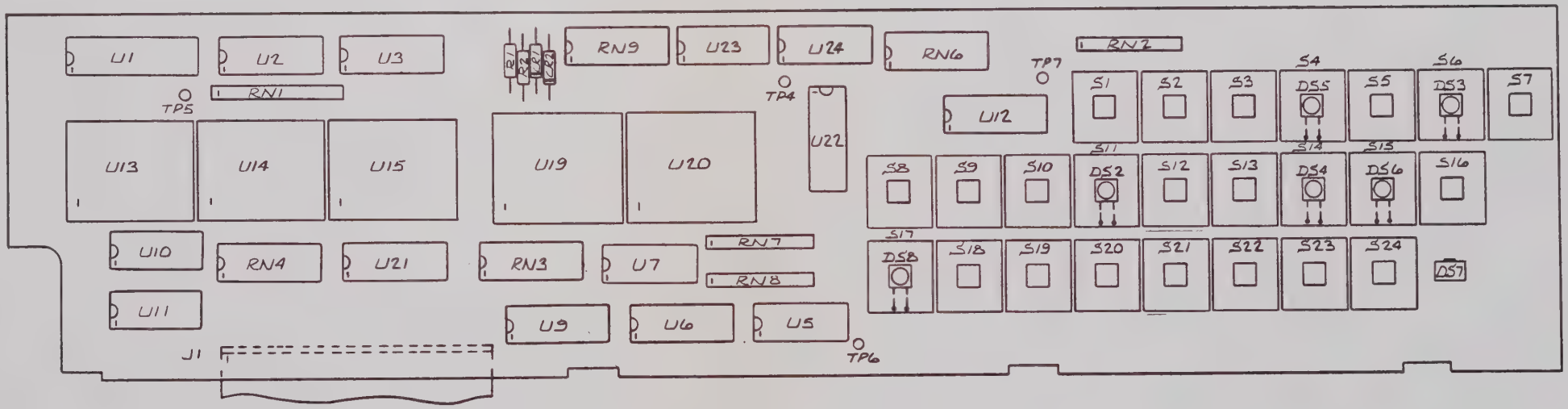
1. ALL RESISTANCE VALUES IN OHMS.
2. ALL CAPACITANCE VALUES IN MICRO-FARADS.

(5) ONLY TO FRONT PANEL.

ANALOG CONTROLLER A/C CONVERTER OHM,S DC BUFFER/I/O SW				
	J19	J20	J21	J22
+27V	7	7	8	7
+15V	6	6	9	6
-15V	5	5	10	5
-15LH	4	4	11	4
-20LC	3	3	12	3
-27V	2	2	13	2
VOLTAGE	INPUT NO.			

8522A-1023

Figure 8-2. Power Supply (cont)



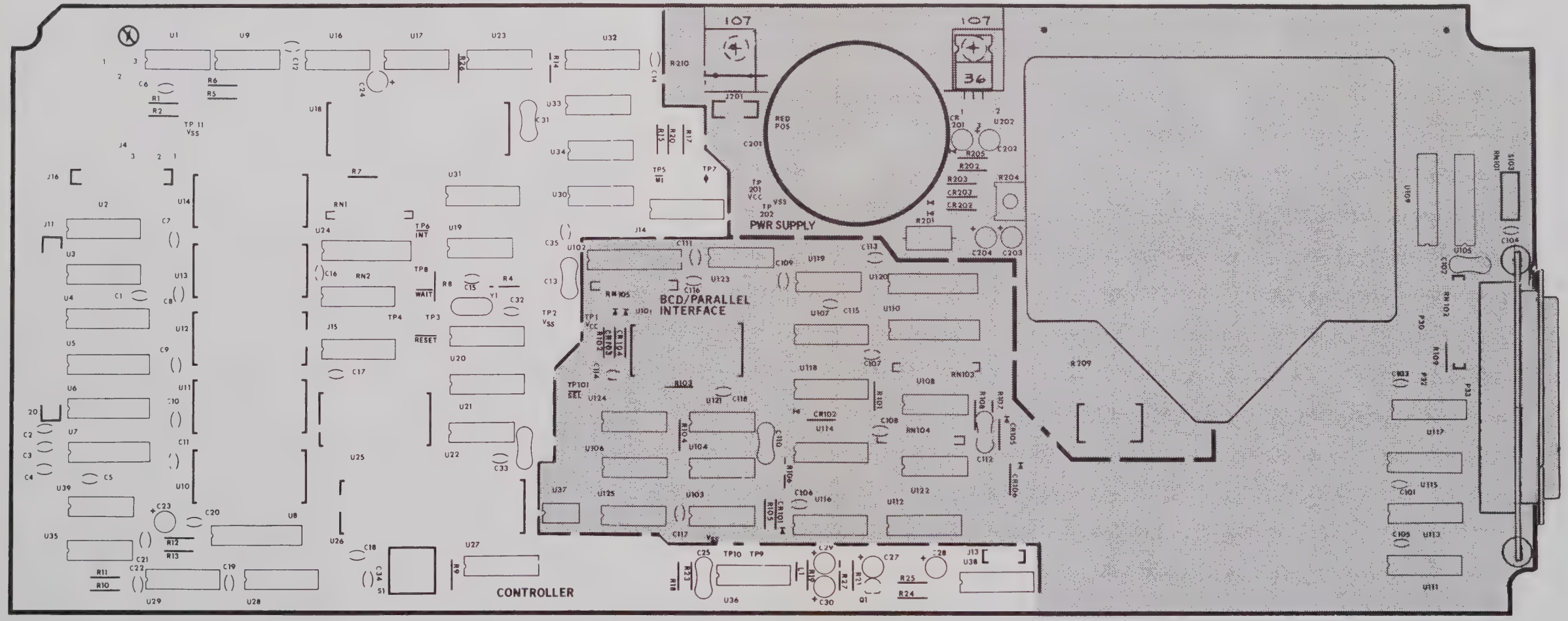
8520A-1611

Figure 8-3. Display PCB Assembly

SWITCH NO	FUNCTION
S1	VDC
S2	VAC
S3	OHMS, 2 T
S4/DS3	OHMS, 4 T
S5	NS
S6/DS3	PRGM IN USE
S7	RESET
S8	STATUS/MENU
S9	BURST SIZE
S10	BURST LOC
S11/DS2	AUTO RANGE
S12	UP
S13	DOWN
S14/DS4	EXT/AUTO
S15/DS6	ARM 8NC
S16	MANUAL
S17/DS8	SHIFT
S18	MATH SEL
S19	MATH DATA
S20	R R FASTER
S21	R R SLOWER
S22	FILT FASTER
S23	FILT SLOWER
S24	LOCAL
S25	REMOTE

Figure 8-3. Display PCB Assembly (cont)

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY



8522A-1620

Figure 8-4. Digital (Controller) PCB Assembly

NOTES: UNLESS OTHERWISE SPECIFIED-
1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL CAPACITANCE VALUES IN MICROFARADS

8522A-1020
1 of 3

Figure 8-4. Digital (Controller) PCB Assembly (cont)

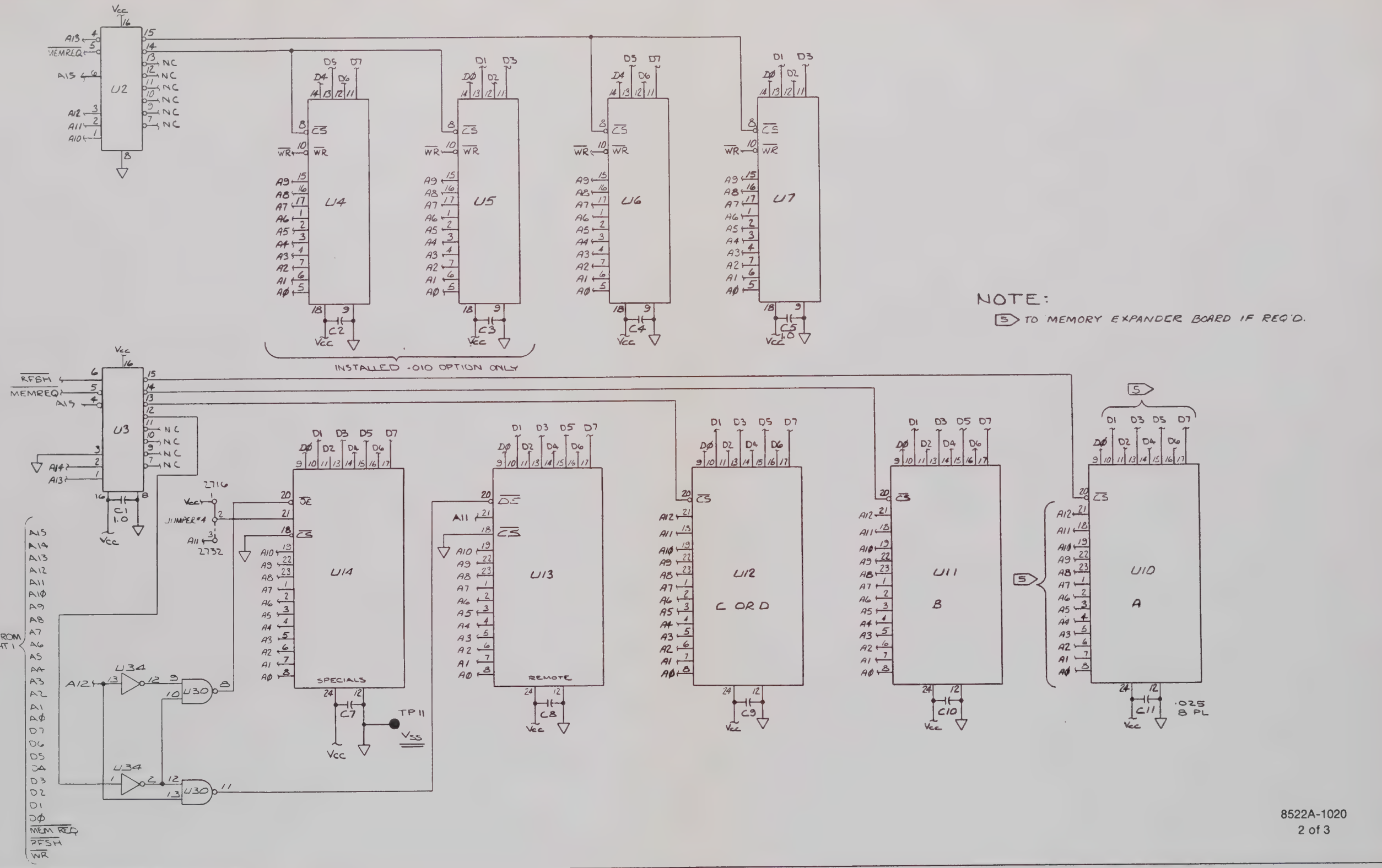
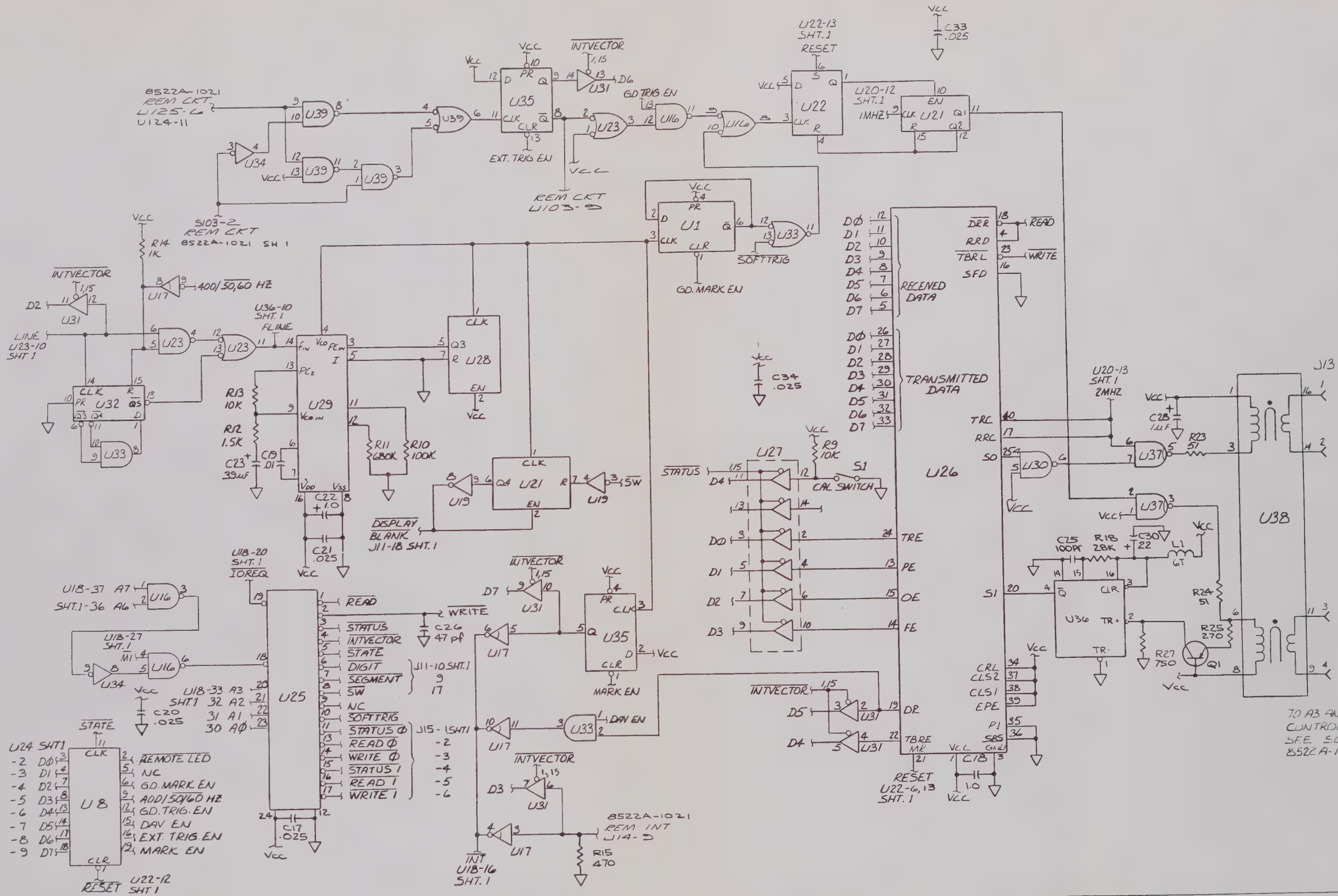


Figure 8-4. Digital (Controller) PCB Assembly (cont)



8522A-1020
3 of 3

Figure 8-4. Digital (Controller) PCB Assembly (cont)

PARA BCD

J8-13 DB7
J8-36 DB6
J8-37 DB5
J8-18 DB4
RN104 2,9,10
Vcc
GPF J8-6
U113
U122
WS4 U101-3
C101

SPARRE J8-34 DB3
RANGE A J8-14 DB2
" B J8-35 DB1
" C J8-17 DB0
RN104 2,3,10
Vcc
GR J8-32
U114
U108
WS4 U101-3

PARALLEL OUT
4TH DIGIT
7 6 5 4
8 J9-30 DB7
4 J9-26 DB6
2 J9-47 DB5
1 J9-27 DB4
RN104 2,9,10
Vcc
G4 J9-28
U115
U122
WS2 U101-4
C106

PARALLEL OUT
3RD DIGIT
3 2 1 0
8 J9-39 DB3
4 J9-40 DB2
2 J9-41 DB1
1 J9-38 DB0
RN104 2,9,10
Vcc
G3 J9-12
U116
U122
WS2 U101-4

2ND DIGIT
8 J8-11 DB7
4 J8-12 DB6
2 J8-13 DB5
1 J8-31 DB4
RN104 2,9,10
Vcc
G2 J8-33
U117
U122
WS1 U101-5

1ST DIGIT
8 J8-10 DB3
4 J8-29 DB2
2 J8-28 DB1
1 J8-27 DB0
RN104 2,9,10
Vcc
G1 J8-30
U118
U108
WS1 U101-5

C103

PARA BCD

PARALLEL IN LSB
7 10K RNG J9-22
6 1000 RNG J9-4
5 100 RNG J9-20
4 10 RNG J9-35
3 1 RNG J9-1
2 .1 RNG J9-19
1 EXT REF J9-2
0 FILTER J9-37
RN102
RN101
U109
RI0 U101-16
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
TO U119-11 & U124-6

PARALLEL IN MSB (8-BIT MODE)
15 J9-42
14 J9-8
13 J9-6
12 J9-24
11 J9-21
10 J9-7
9 J9-23
8 J9-25
RN103
RN102
U110
RI1 U101-15
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
C107

PARALLEL OUT (8 BIT MODE)
15 REMOTE J9-31
14 EXT REF J9-32
13 FILTER J9-15
12 POLARITY J9-14
RN104 2,9,10
Vcc
GSF J9-9
U111
U122
WS3 U101-2
C105

PARALLEL OUT (8 BIT MODE)
11 10 9 8
5TH DIGIT
8 J9-43
4 J9-44
2 J9-45
1 J9-29
RN104 2,9,10
Vcc
G5 J9-13
U112
U122
DB3 DB2 DB1 DB0 WS3 U101-2
C108

Vcc
C104

S103
RN101
3/4 IN OR AC+DC/AC
2/4 TERM OR 16 BIT/8 BIT
BCD/PARA IN
EXT TRIG EDGE U39-1, U34-3
8522-1020 SHT 3
J9-34 SHIELD J8-3
C102 5pf

Vcc
Vss
8522A-1023

Vcc
C110
C107

Vcc
C105

Vcc
C111
C108

Vcc
C112
C109

RN102
GOL J8-26
U108
PAR REM/OVERLOAD J9-3
U119
PFLG/TRIGGER J9-36
U119
OVERRANGE J8-22
U119
GOR J8-16
U108
RN104

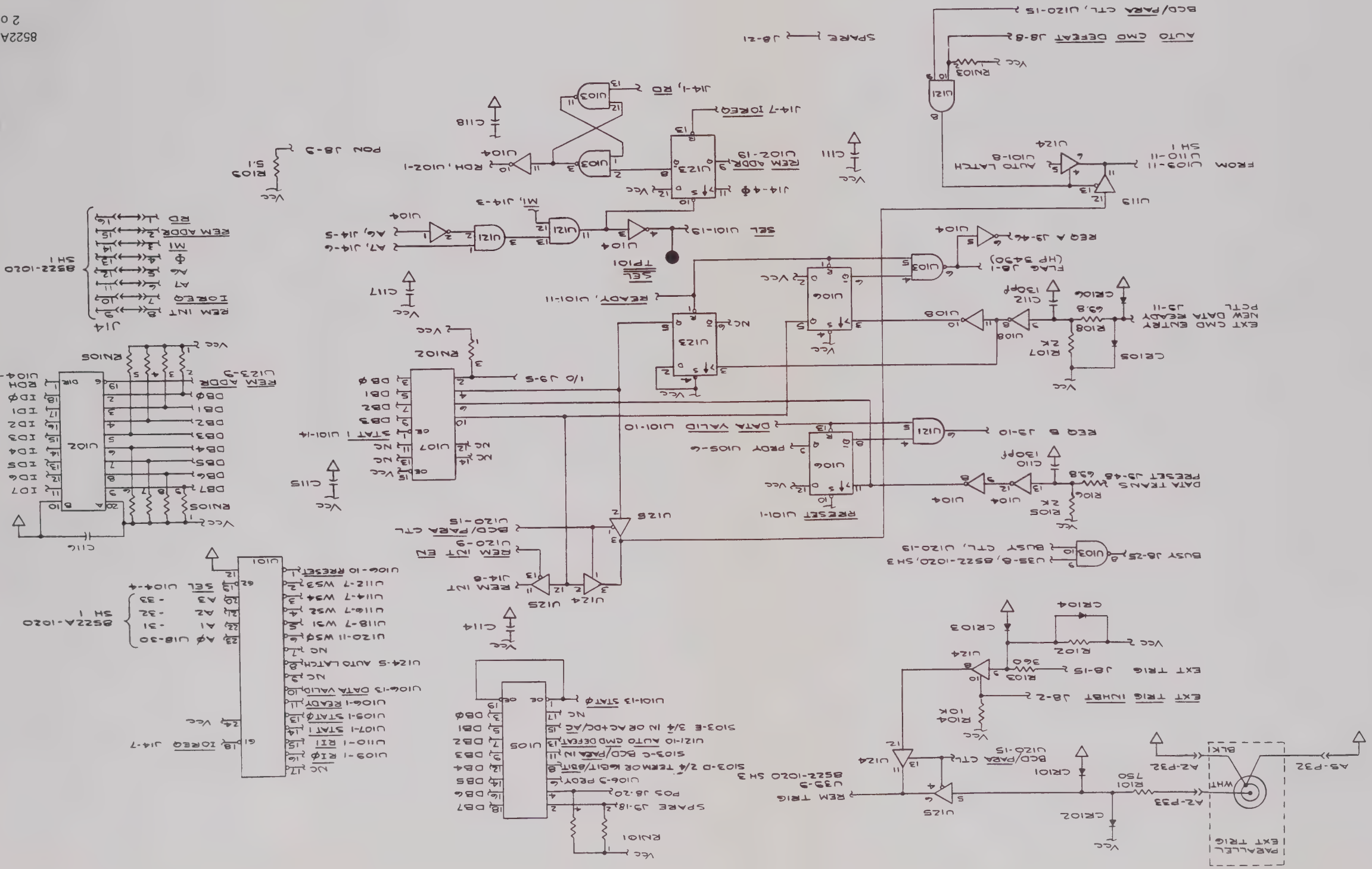
U103-10 BUST CTL
SAMPLE SYNC J8-7
BCD/PARA CTL
U125-13 REM INT EN
NC
U120
WS0 U101-6
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0

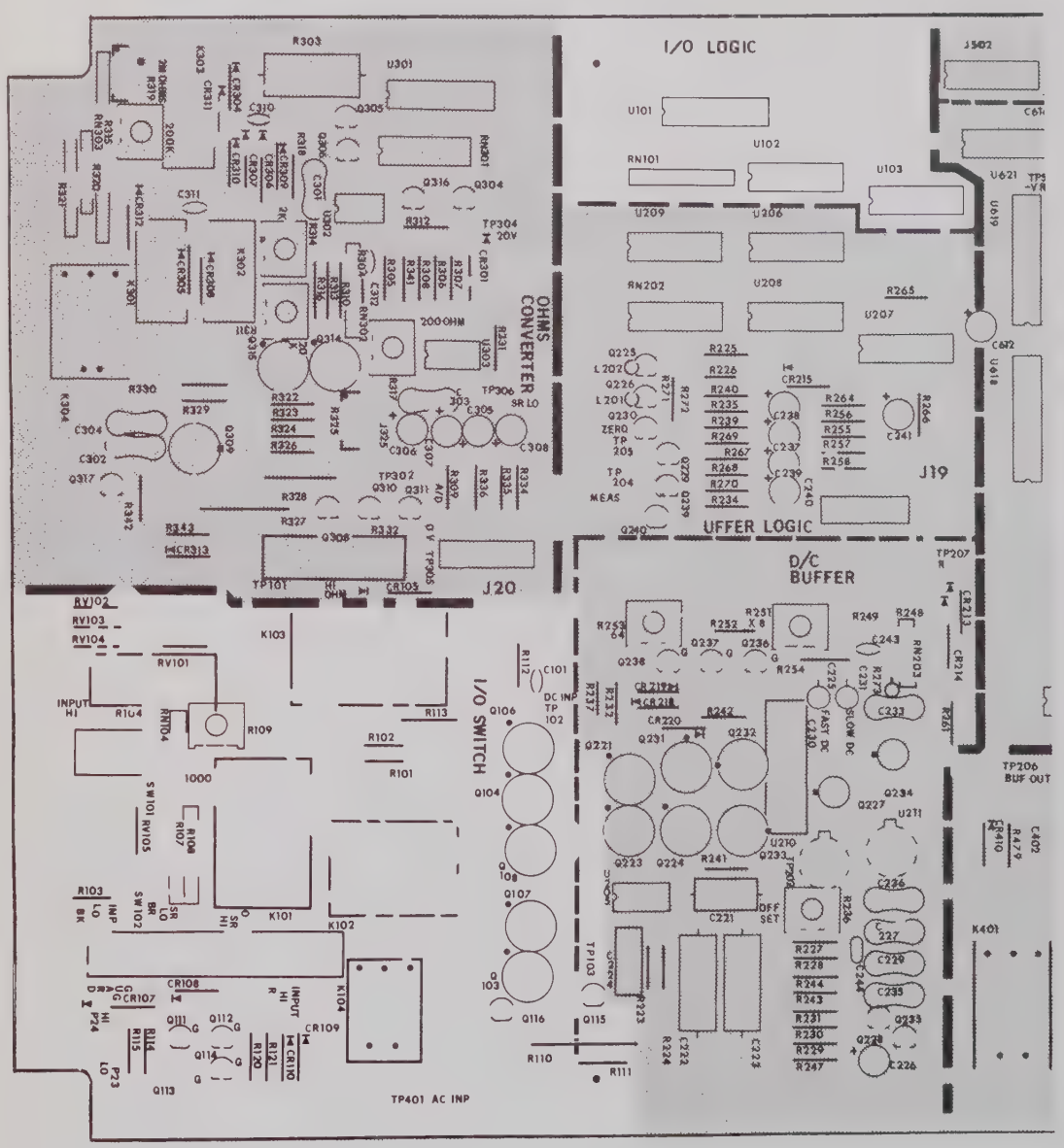
Vcc
C113

NOTES:- UNLESS OTHERWISE NOTED
1. ALL CAPACITANCE VALUES ARE .025 mf.
2. ALL RESISTANCE VALUES ARE 10K.

8522A-1021
1 of 2

Figure 8-5. Remote Interface (cont)


8522A-1021
2 of 2
PARALLEL EXT TRIG
A2-P32
A3-P32
BLK
WHT
A2-P33
R101 750
CR101
CR102
U12S
U33-3 8522-1020 SH 3
REM TRIG
BCD/PARA CTL, U120-15
U12A
CR103
CR104
R102
EXT TRIG INHBT J8-2
R104 10K
EXT TRIG J8-15
R103 360
U12A
U10A
U10C
FLAG J8-1 (HP 3450)
REQ A J9-4
U10B
R108 63.8
R107 2K
C112 130PF
CR105
EXT CMD ENTRY NEW DATA READY PCTL J5-11
U11B
FROM U109-11 U110-11 SH 1
AUTO LATCH U101-8
U12A
U11A
AUTO CMD DEFEAT J8-8
BCD/PARA CTL, U120-15
R110 2K
C110 130PF
DATA TRANS PRESET J9-4
U10A
U10A
R103
BUSY J8-25
U35-8, 8522-1020, SH 3
BUSY CTL, U120-19
U10D
U12B
U10E
U10F
U11A
U11B
U12A
U12B
U10C
U10D
U10E
U10F
U11A
U11B
U12A
U12B
U10A
U10



Part of
8522A-1630

Figure 8-6. Input/Output Switching

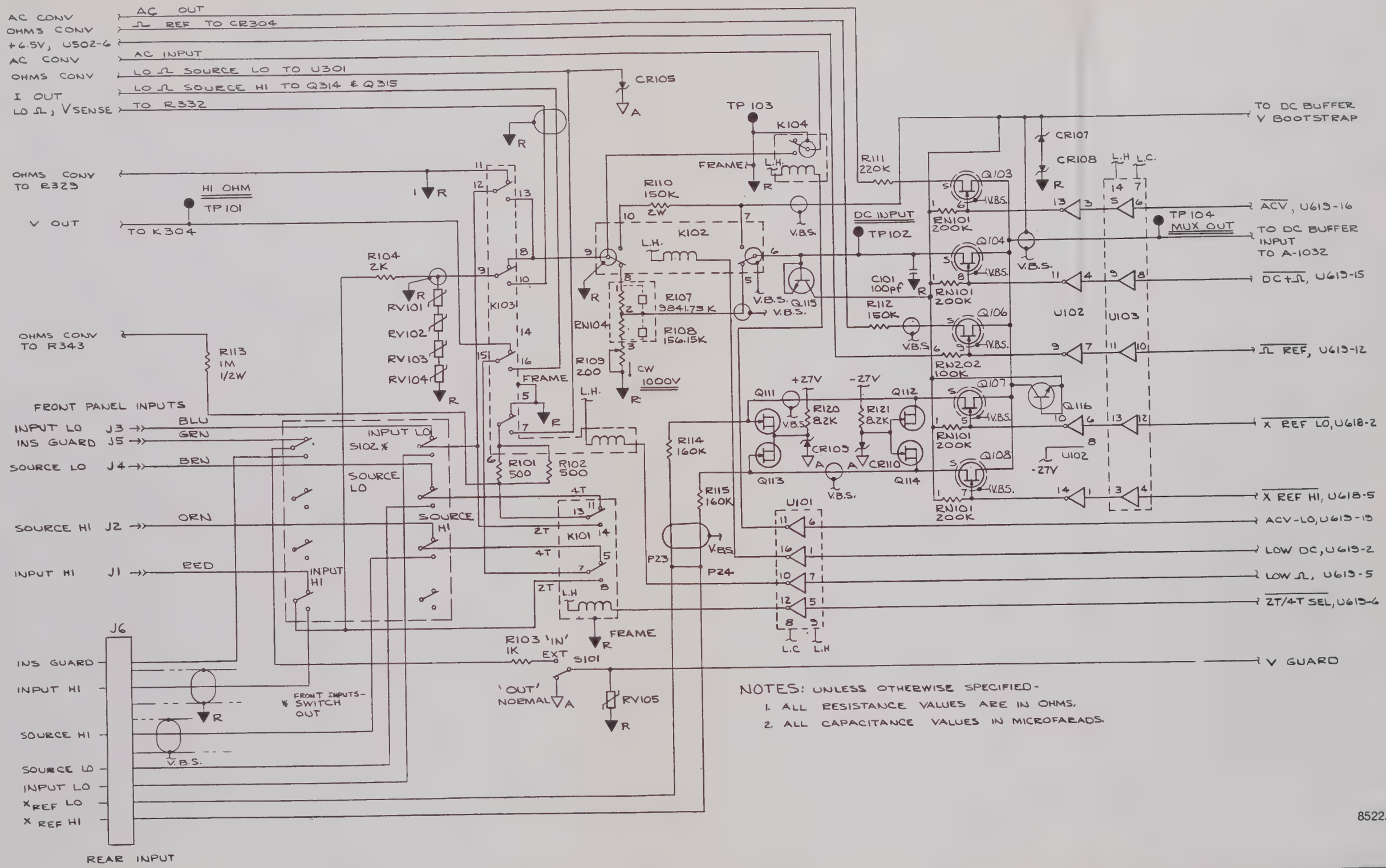
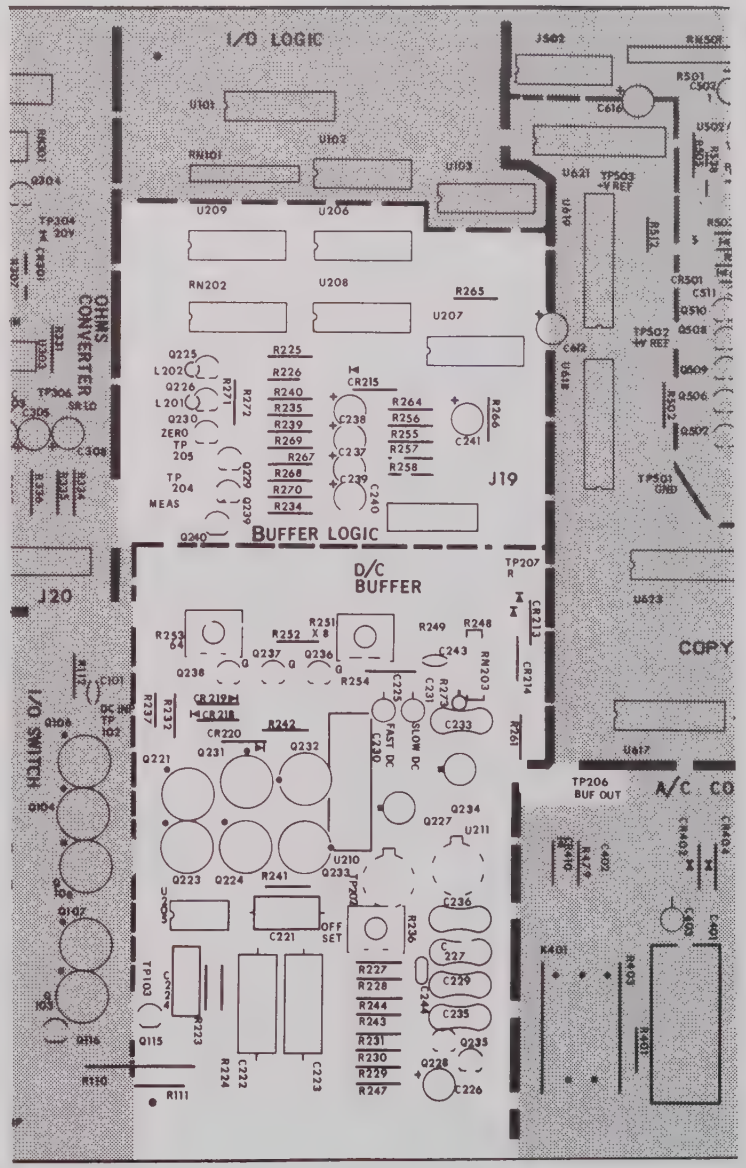
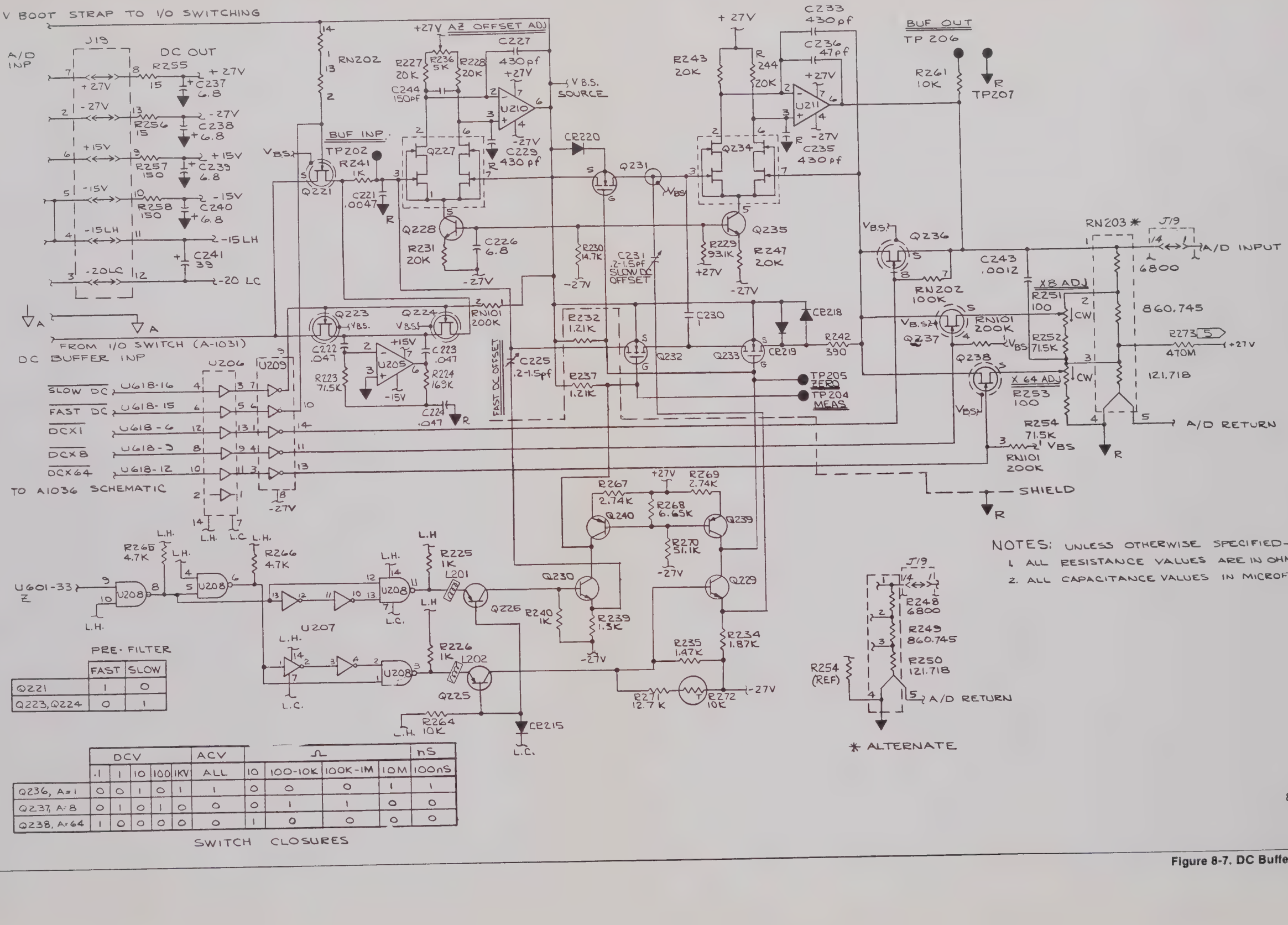


Figure 8-6. Input/Output Switching (cont)



Part of
8522A-1630

Figure 8-7. DC Buffer



PRE-FILTER

	FAST	SLOW
Q221	1	0
Q223, Q224	0	1

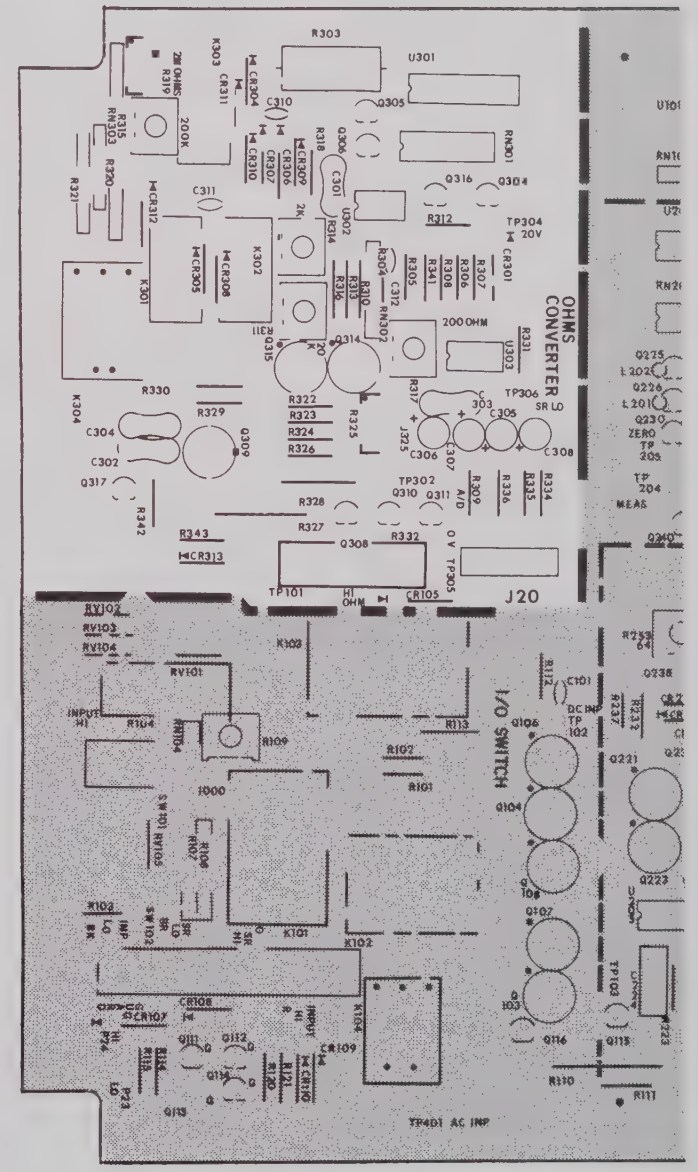
	DCV					ACV	Ω				nS
	.1	1	10	100	1KV	ALL	10	100-10K	100K-1M	10M	100nS
Q236, A=1	0	0	1	0	1	1	0	0	0	1	1
Q237, A=8	0	1	0	1	0	0	0	1	1	0	0
Q238, A=64	1	0	0	0	0	0	1	0	0	0	0

SWITCH CLOSURES

NOTES: UNLESS OTHERWISE SPECIFIED-
1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

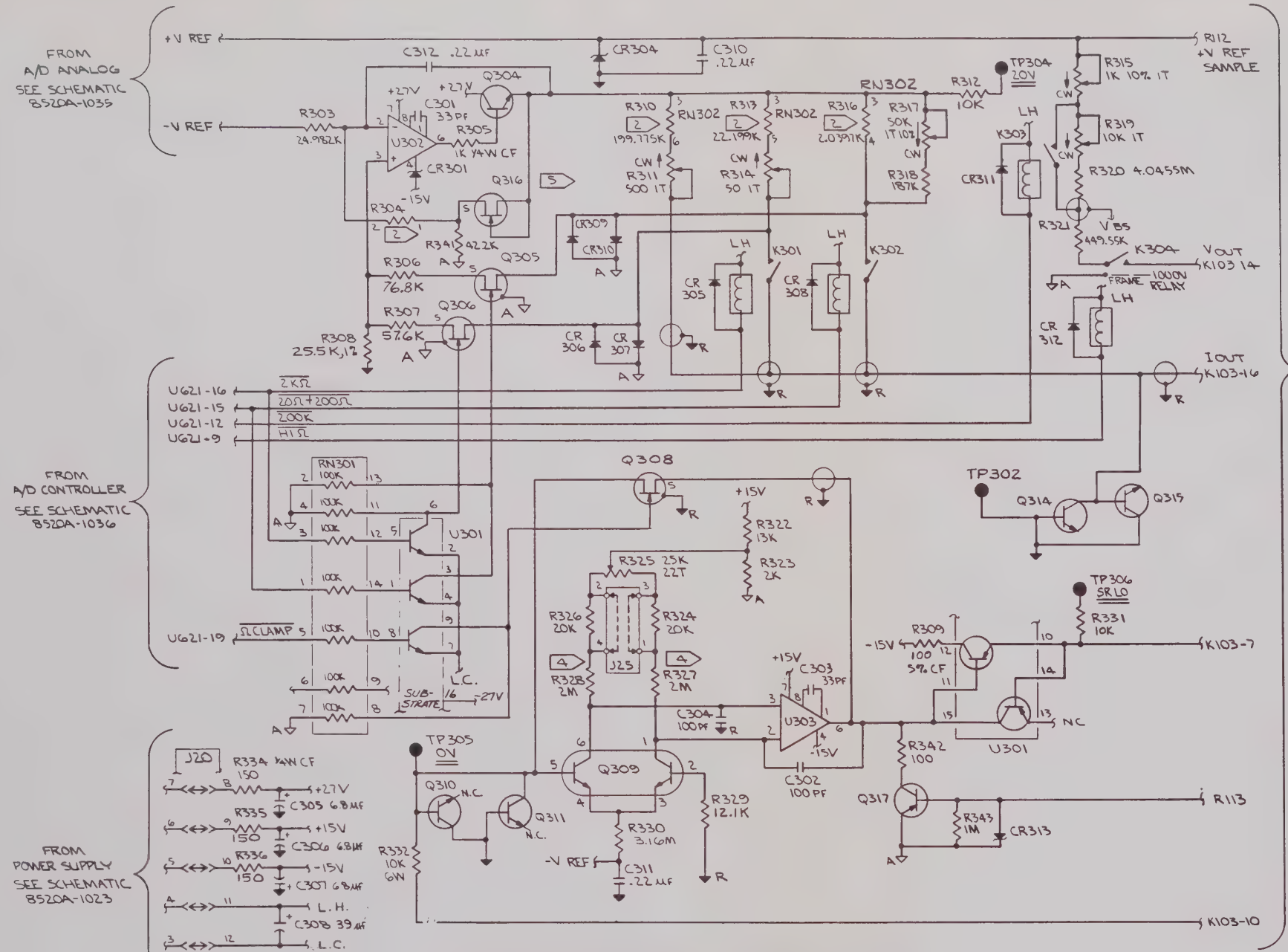
8522A-1032

Figure 8-7. DC Buffer (cont)



Part of
8522A-1630

Figure 8-8. Ohms Converter



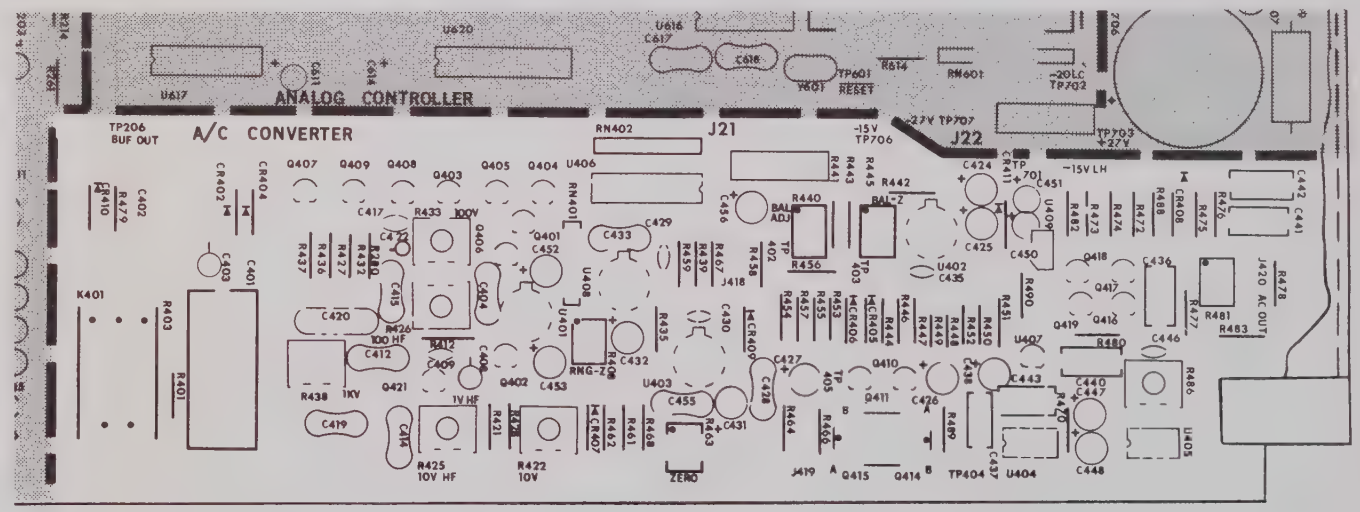
RANGE	FUNCTION	Q308	Q305	Q306	K302	K301	K304	K303
X	DC	1	0	0	0	0	0	0
10	LO Ω	0	1	0	1	0	0	0
100	LO Ω	0	1	0	1	0	0	0
1000	LO Ω	0	0	1	0	1	0	0
10K	LO Ω	0	0	0	0	0	0	
200K	HI Ω	1	0	0	0	0	1	1
2MΩ 20MΩ & NS	HI Ω	1	0	0	0	0	1	0

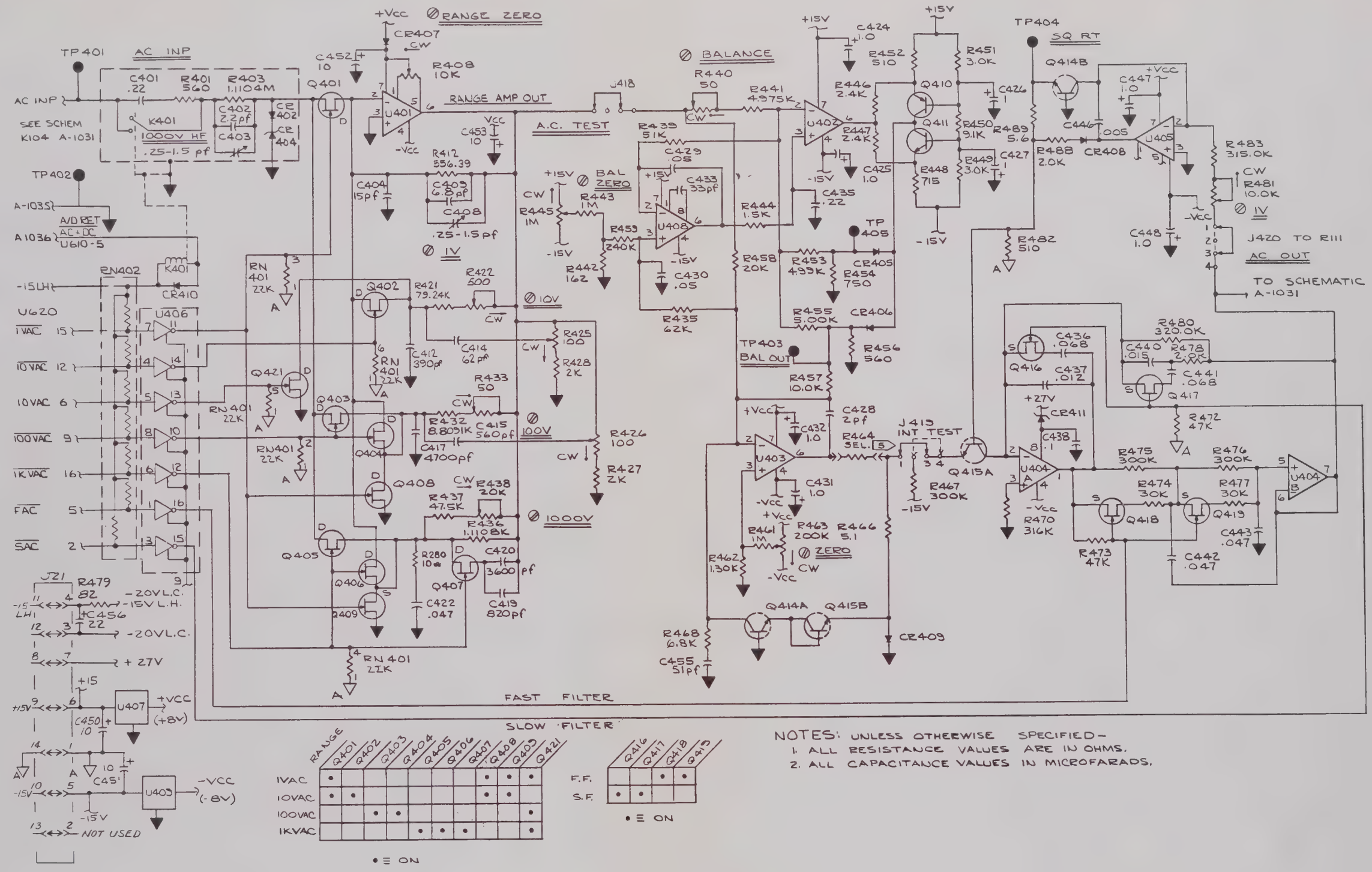
NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTORS - 1/8 W M.F. 1%
2. DUAL LAYOUT FOR 4 INDIVIDUAL PARTS OR J.F. NETWORK RN302.
4. MATCHED SET
5. Q316 IS A MATCHED SET WITH Q510 & Q511 A/D ANALOG SCH -1035

8522A-1033

Figure 8-8. Ohms Converter (cont)

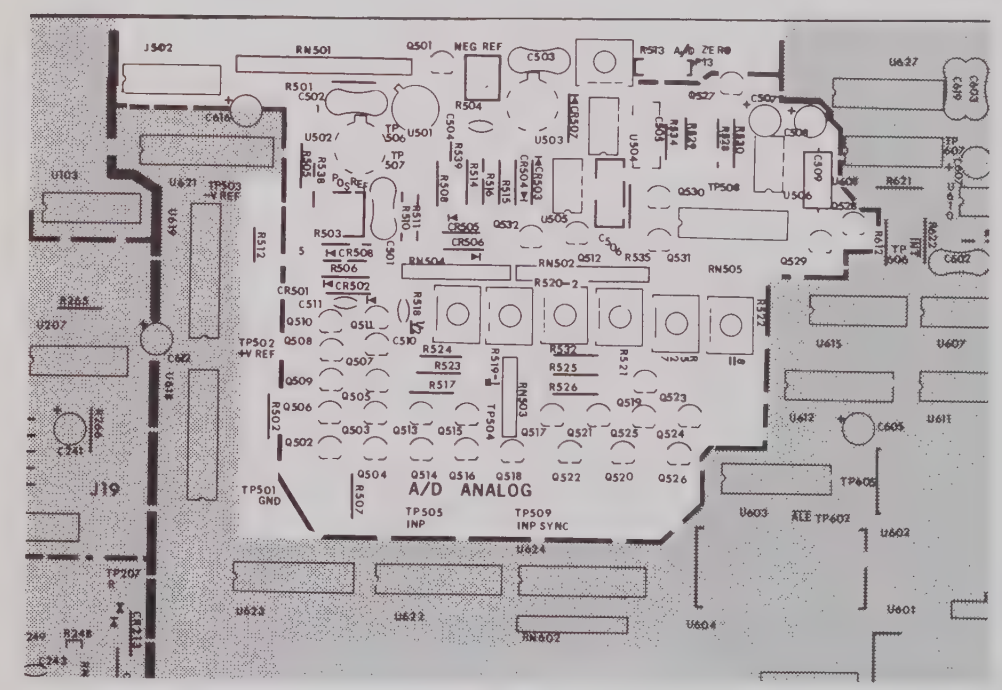

ANALOG CONTROLLER
A/C CONVERTER
J21
J22
TP206 BUF OUT
-15V TP706
-27V TP707
+27V TP703
-20LC TP702
-15V LH
TP601 RESET
U616
U617
U620
C617
C618
R614
RN601
V601
C611
C614
RN402
R443
R441
R442
C424
C451
U409
C425
C450
U402
C435
R440
BAL ADJ
C456
TP 402
R456
TP 403
R458
J418
R490
Q418
Q417
Q419
R480
C436
C446
R481
R483
J420 AC OUT
R478
R477
C442
C441
R476
R475
R488
CR408
R472
R474
R473
R482
R431
U407
C438
C443
C440
C447
R470
U405
C448
Q410
Q411
C426
R489
C437
TP404
U404
J419
Q415
Q414
R464
R465
C427
C428
TP 405
C430
C431
U403
C455
R463
R468
R461
R462
CR407
ZERO
R425 10V HF
R422 10V
C421
C419
R438 1KV
C412
R426 100 HF
C420
C409
C408
Q402
C453
R421
R412
R435
R459
R467
R457
R454
R453
R455
CR406
CR405
R444
R446
R447
R449
R448
R452
R450
C432
RNG-ZR
C433
C429
R433 100V
C417
C418
C415
R430
R432
R427
R436
R437
Q406
C404
C452
U401
U408
RN401
Q401
Q407
Q409
Q408
Q403
Q405
Q404
U406
C403
C401
K401
R403
R401
R410
R479
C402
CR402
CR404
C414
C416
C422
C423
C405
C407
C410
C411
C413
C434
C444
C445
C454
C457
C458
C459
C460
C461
C462
C463
C464
C465
C466
C467
C468
C469
C470
C471
C472
C473
C474
C475
C476
C477
C478
C479
C480
C481
C482
C483
C484
C485
C486
C487
C488
C489
C490
C491
C492
C493
C494
C495
C496



NOTES: UNLESS OTHERWISE SPECIFIED—
1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

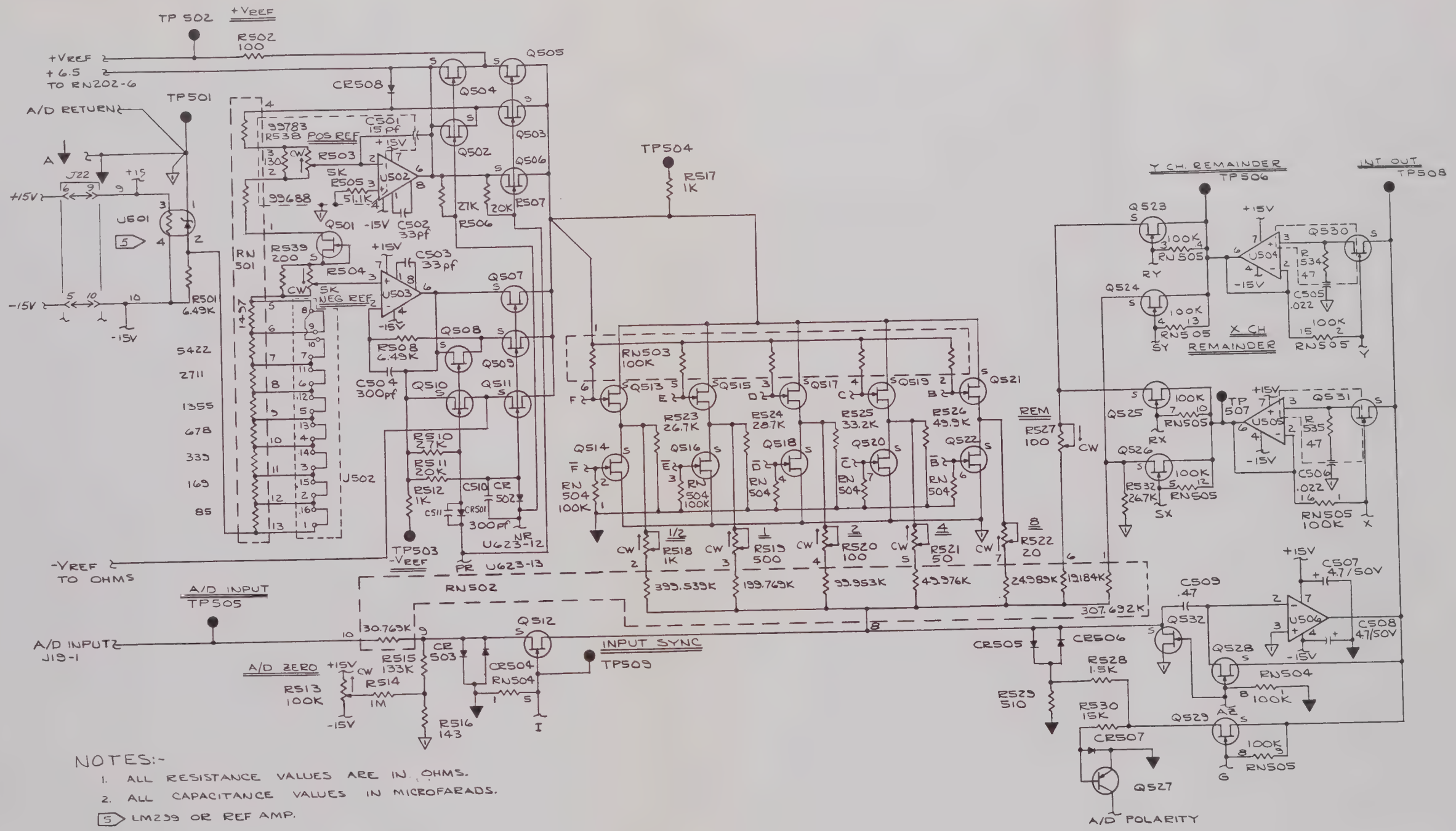
8522A-1034

Figure 8-9. AC Converter (cont)



Part of
8522A-1630

Figure 8-10. A/D Analog



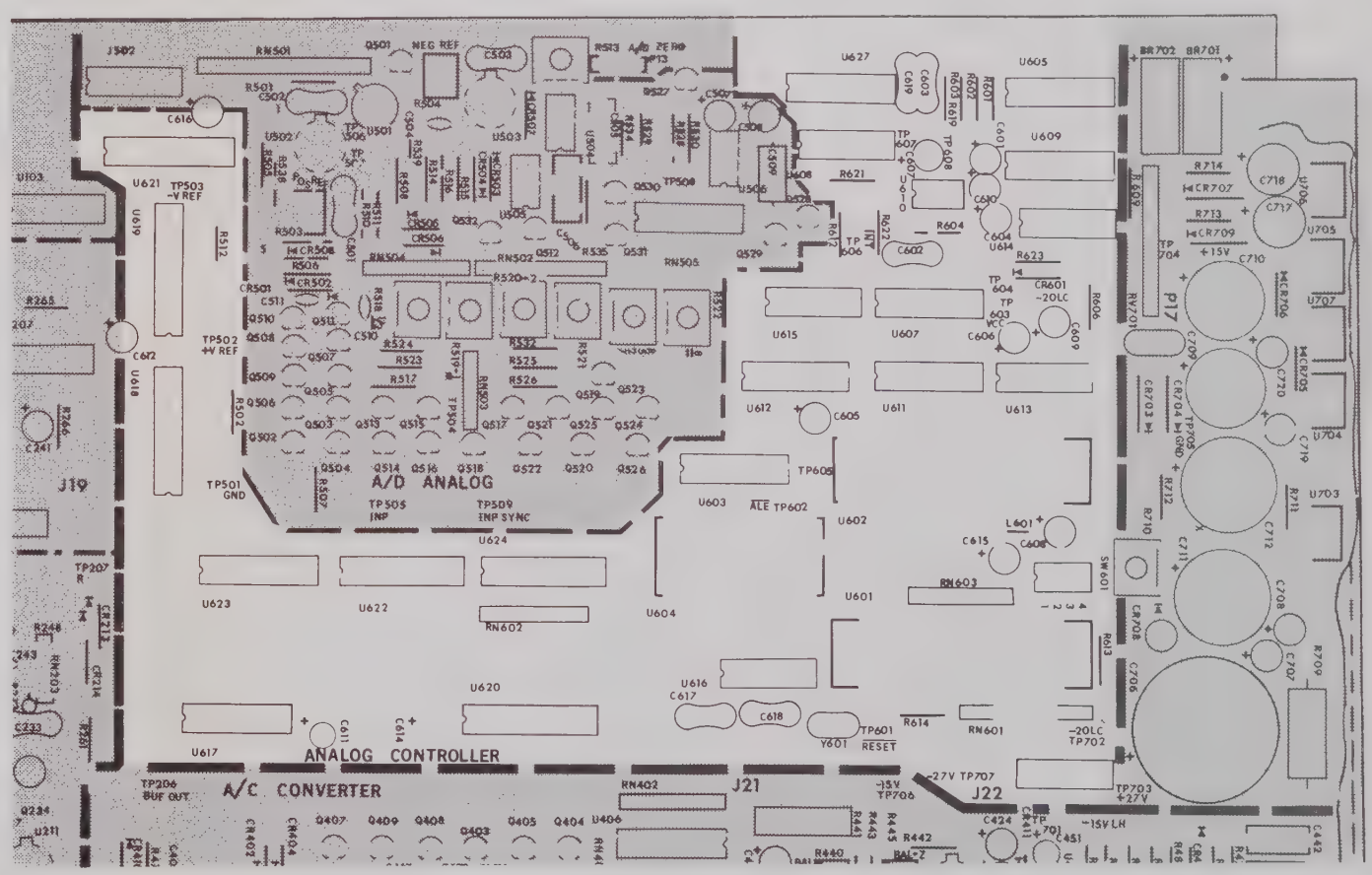
NOTES:-

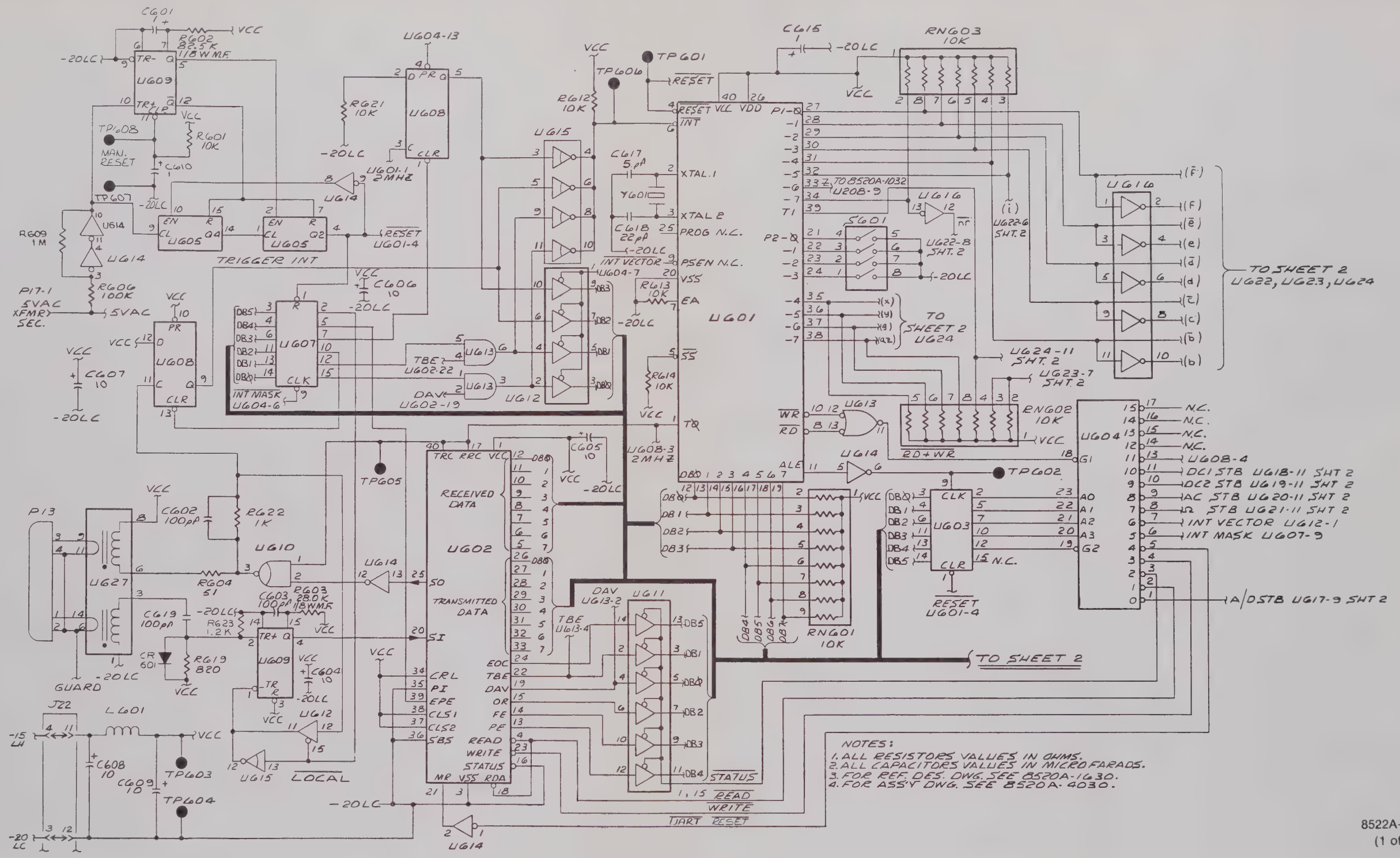
1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.

(5) LM239 OR REF AMP.

8522A-1035

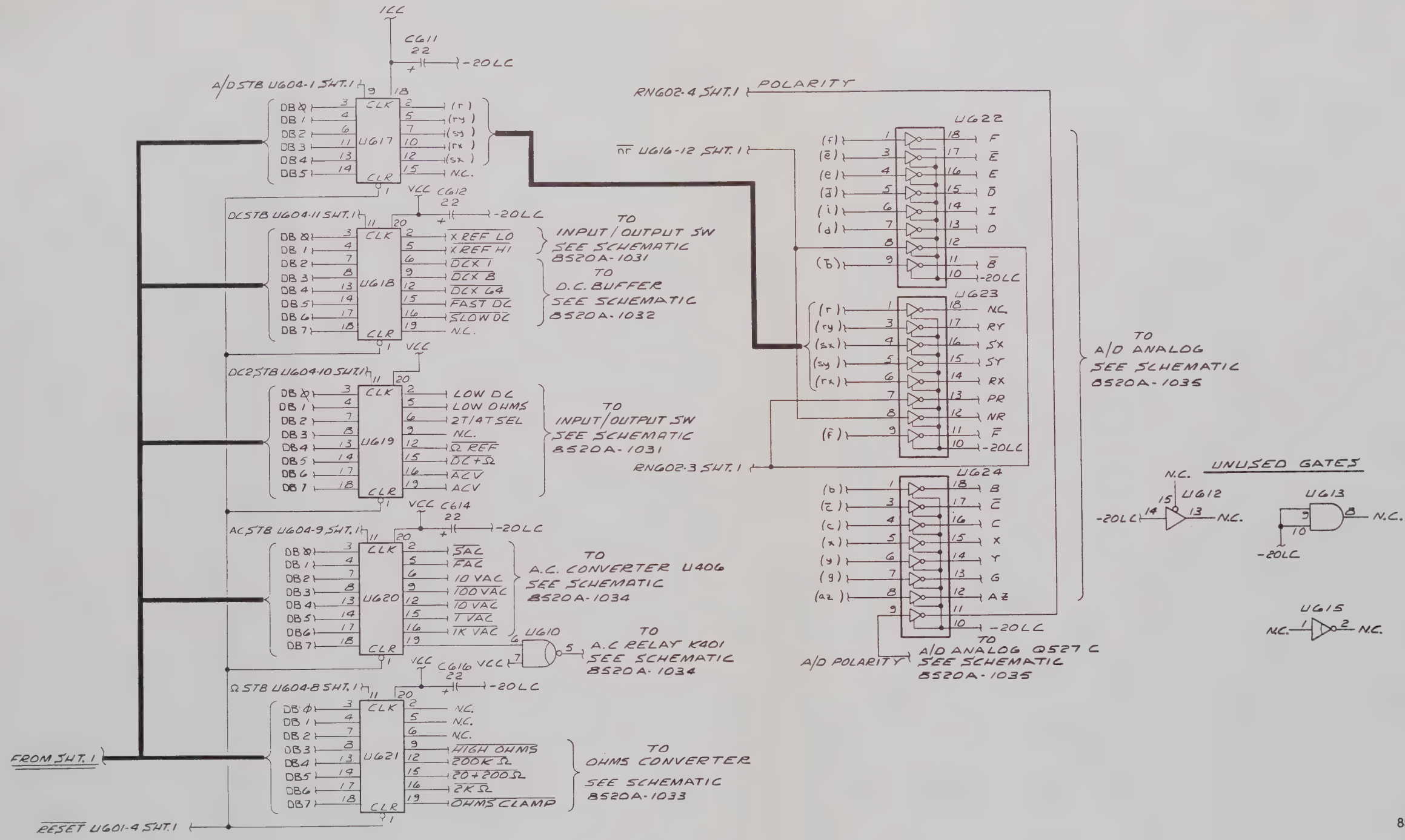
Figure 8-10. A/D Analog (cont)


A/D ANALOG
ANALOG CONTROLLER
A/C CONVERTER
J19
J21
J22
U624
U623
U622
U604
U603
U602
U601
U620
U617
U616
U627
U605
U609
U615
U607
U612
U611
U613
U621
U619
U618
U610
U703
U704
U705
U706
U707
U708
U709
U710
U711
U712
U713
U714
U715
U716
U717
U718
U719
U720
U721
U722
U723
U724
U725
U726
U727
U728
U729
U730
U731
U732
U733
U734
U735
U736
U737
U738
U739
U740
U741
U742


TRIGGER INT
TO SHEET 2
UG22, UG23, UG24
TO SHEET 2
NOTES:
1. ALL RESISTORS VALUES IN OHMS.
2. ALL CAPACITORS VALUES IN MICROFARADS.
3. FOR REF. DES. DWG. SEE 8520A-1630.
4. FOR ASS'Y DWG. SEE 8520A-4030.

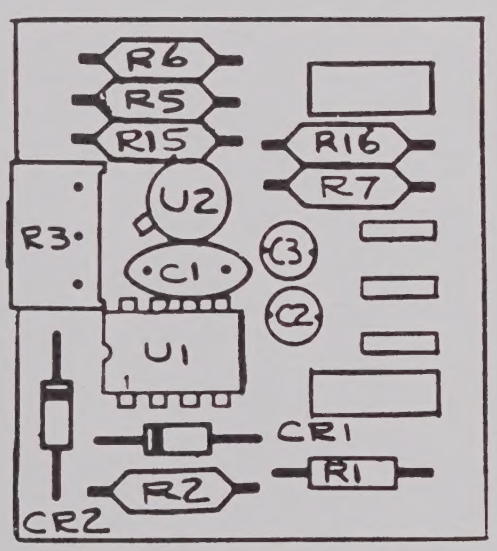
8522A-1036
(1 of 2)

Figure 8-11. Analog Controller (cont)



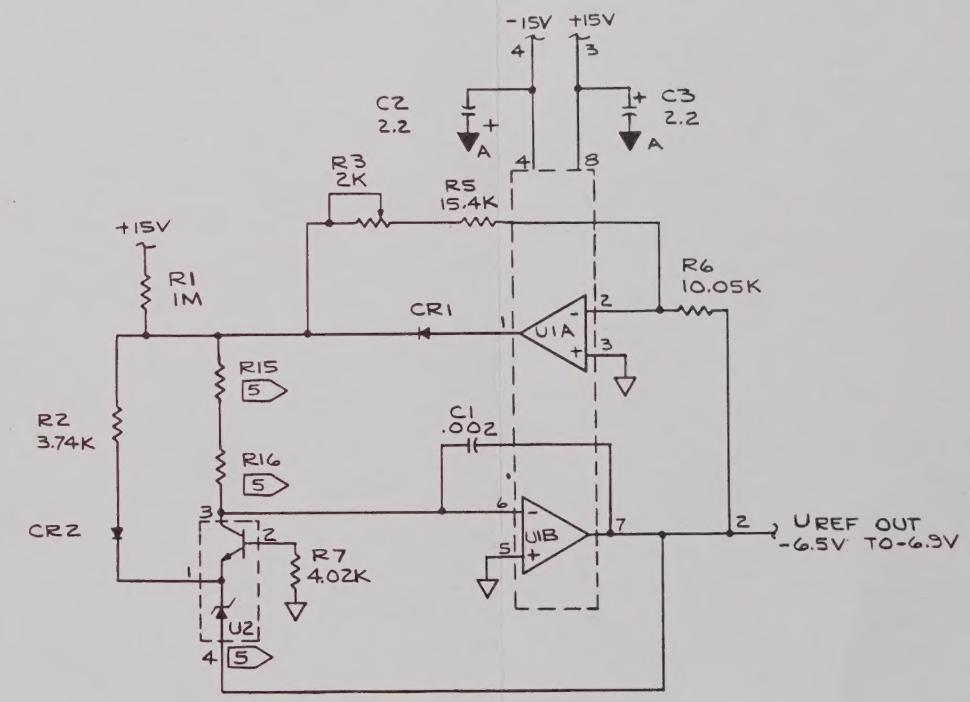
8522A-1036
(2 of 2)

Figure 8-11. Analog Controller (cont)



VERTICAL

8520A-1646



NOTES:-

1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL CAPACITANCE VALUES IN MICROFARADS.
5 MATCHED SET

8520A-1045

Figure 8-12. Reference Module PCB Assembly

www.manualsplus.com
1014334